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Evaluation of Wheat Promising Lines under On-Farm Conditions

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Research Article

Abstract

Receiving high and stable grain yield at different environments is one of the aims of cereal breeding programs. In order to compare results of research under on-farm conditions, it is necessary carrying out research project to receive high grain yield and superior characteristics lines. In this study, C-89-6 (Fdo 2062), C-89-7 (Zarin*2/Gaspard) and C-89-15 (Fdo 4085) promising lines and Mihan as control cultivar sowed under irrigated and on-farm conditions in Urmia and Oshnavieh cities. Planted area for each genotype at per location was 5000 m^2. Land preparation and sowing accomplished according common region and on-farm conditions. Seed rate based on 1000-kernel weight and manure consumption were 450 seed/m^2 and according recommendation of soil experiment, respectively. Results of combined analyses of variance showed that for except of spike length and 1000 kernel weight were significant differences for all traits at two locations. Also, among genotypes, for except of grain yield and harvest index other traits were significant differences. The highest grain yield and total dry matter related to the Oshnavieh city with 1052 and 1990g/m^2, respectively. Standard deviation and standard error of genotypes in this city was more than Urmia. With harvesting total planted area and measuring grain yield, C-89-15 line in both cities of Urmia and Oshnavieh produced more grain yield than other genotypes 7.5 and 8.0 t/h, respectively. Higher yield for this line is due to long spike length, the number of spikelets at per spike, number of kernels at per spike and number of spike at per square meter. One thousand spikes provided for producing breeder seed.

Keywords: Cold climate; Grain yield and its components; On-farm trial; Promising line; Winter wheat.

1. Introduction

Since more than one hundred twenty thousand hectares wheat has sown in the west Azerbaijan province of Iran. It is the first product within crops and one of the main sources of income who farmers planting wheat. Therefore identifying lines with high yield potential and compatible with limiting production of conditions in terms of income and employment is important in the province [1-10].

There are different methods and tools for technology transfer to the farmer's field. On-farm research has been known as an essential implement and effective method for developing and transmitting the new applied researchers' results into the farmers' field [10-18]. It also has an indispensable duty for screening and substantiation of farming applied science under local farmer's conditions. Furthermore, on-farm research creates suitable conditions for participatory management of the researchers, extension agents and farmers for the finding of agricultural problems in the rural areas [18]. In order to transmit the new applied researchers' results into farmers' field, Moayedi [8] compared promising drum wheat lines in two farmer's field. Results showed that there were significant differences for interaction of genotype × location on grain yield. D-84-3 produced the highest grain yield and it might be used as stable breeding materials under farmer's field conditions [8].

Grain yield and its stability of wheat genotypes are important in breeding programs. This can be used to select promising wheat genotypes across multi environments. Therefore Aydin et al. [2] sowed different wheat genotypes in seven environments in central black sea region and selected three genotypes for release procedure with good yield potential and acceptable end use quality. Ahmadi et al. [1] in targeting promising bread wheat lines for cold climate environments with using of AMMI and GGE bi-plot analyses found two lines had high grain yield at different environments. They concluded that AMMI and GGE bi-plots facilitated visual comparison and identification of superior genotypes [1]. Khan et al. [6] in evaluating five promising wheat lines revealed that the overall mean grain yield of genotypes across environments ranged from 1198 to 2202 kg/ha at three locations under rainfall conditions of Balochistan, Pakistan. Cultivar "AZRC-3" having regression coefficient close to unity and higher grain yield showed consistent performance and considered as stable and widely adopted [6]. Khajavi et al. [5] tested genetic diversity of twenty barley lines based on pheno-morphological traits and selected five promising lines. These genotypes introduced as superior lines for releasing and replacing common cultivars [5]. Nabaty and Shaban [11] compared barley promising lines under two temperate locations of Iran. Results showed that barley yield in Boroujerd was the highest for "MB83-3" line and in Dorud location was the highest for common Nosrat cultivar. They selected line of "MB83-3" for complimentary studies [11]. Mohammadi and Haghparast [10] in analyzing of genotype by farmers' field trials data showed that the farmers' field main effect was the predominant source of variation. Great variations exit in the agro ecological conditions within the region in terms of altitude, temperature, and soil characteristics, etc.; therefore Baig et al. [3] evaluated wheat promising lines for grain yield over three locations. Results showed that "Chakwal-97" line gave higher grain yield with 4955 $kgha^{-1}$. Ramazani and Tajalli [13] in testing triticale promising line recommended ET-83-18 new line can be replaced by Juanillo-92 old cultivar under Birjand and similar areas conditions of Iran. The objective of this research was evaluation wheat grain yield promising lines of C-89-6, C-89-7 and C-89-15and comparison of them with Mihan as control cultivar and possibility replacing with old and conventional varieties under on farm conditions.

2. Materials and Methods

Two field experiments were conducted in cropping seasons of 2014-2015 under on-farm conditions at Urmia and Oshnavieh cities. Three promising lines including C-89-6 (Fdo 2062), C-89-7 (Zarin*2/Gaspard) and C-89-15 (Fdo 4085) evaluated with Mihan cultivar as a control. Each genotype was planted at 0.5 hectare at two locations under optimum growth conditions. At harvesting time 10 samples randomly selected and areas of each harvesting sample were 2 square meter for each genotype at two locations. Evaluated traits were plant height, spike length, number of spikelets at per spike, grains per spike, number of spikes at per square meter, 1000-kernel weight, grain yield, total dry matter and harvest index. In addition, Grain yield of total area were measured separately for each genotype at two locations. Husbandry operations were carried out based on conventional methods. So, the field was deep plowing in April and spread triple super phosphate fertilizer at the rate of 100 kg per hectare and was hit hard in August. At the time of cultivation (15 September and 30 October) nitrogen fertilizer was applied based on soil test about 200 kg per hectare. 70 kg per hectare nitrogen based fertilizer was spread at first time and the rest was added at two stages during stem elongation and heading. Cultivation was carried out with farmers' method. Furrow irrigation was done five times at growing stages until physiological maturity. To prevent smut infection, before sowing, seeds were sterilized with Carboxyinthiram fungicide. For weed controlling Topic and Ganstar toxins were used for broad-leaf weeds and grasses at the stem elongation stage, respectively. During the period of plant growth, germination time, cold damage, date of tillering, number of days to heading and maturity were recorded.

3. Climatic Conditions

Cities of Urmia and Oshnavieh were located in West Azerbaijan province, Iran and had semi-arid region. Period of below-freezing temperature was 90 to 100 days which in seasons of January, February and March reached to its minimum values (Table 1).

Autumn rain almost starts from late of October and most rainfall occurs when plant growth is low and slow. With increasing temperature, precipitation cut and evaporation rate arise in the second half of the May. During grain filling period in May and cut off rainfall, in addition, temperature rise, relative humidity reduce and hot winds start and blast damage can be seen in various areas.

4. Statistical Analysis

The skewness to the right, left and kurtosis of data were calculated with Mstat-C software for regions of Urmia and Oshnavieh. After ensuring be normal data, simple and combined analysis of variance based on randomized complete blocks design (RCBD) were done with Mstat-C software. Significant Fischer values of traits selected for man comparison of genotypes. Means of genotypes, locations and interactions between them were compared with Duncan's multiple range tests. Range of variation, standard deviation, coefficient of variation calculated for regions of Urmia and Oshnavieh and C-89-6, C-89-7, C-89-15 and Mihan genotypes.

5. Results and Discussion

Skewness and kurtosis of data were calculated to ensure normal distribution of nine traits of Urmia and Oshnavieh conditions. Results showed that data were normally distributed and hadn't statistically significant difference with Student's t test ($p \leq 0.05$) (Table 2). For achieving the most possible grain yield on a given site, farmers must use promising lines that are adapted to particular environments, which fluctuate with different seasons and locations as like our results [4].

Table 1. Meteorological parameters of Urmia and Oshnavieh experimental locations in seasons of 2014-2015.

	Urmia Experimental Location											
Parameter	**October**	**November**	**December**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**
(mm) Precipitation	162	16	21	1	13	33	15	43	6	---	---	10
Maximum temp. (°C)	29	18	11	12	15	16	26	29	33	39	38	35
Minimum temp. (°C)	-1	-5	-4	-11	-7	-8	-3	0.4	7	10	12	12
Average temp. (°C)	14	6	3	0.7	3	6	10	15	20	25	25	20
Maximum humidity (%)	90	91	93	89	88	81	80	77	59	61	61	80
Minimum humidity (%)	43	48	63	48	39	35	33	29	33	20	17	31
Sunny (h)	210	180	73	167	197	215	240	283	339	386	366	295
Evaporation (mm)	111	25	---	---	---	---	32	206	278	279	284	164
Frosty (day)	1	13	12	29	27	17	5	1	---	---	---	---
	Oshnavieh Experimental Location											
(mm) Precipitation	177	41	59	11	37	50	61	67	7	---	---	10
Maximum temp. (°C)	29	20	11	14	15	17	23	27	31	37	37	35
Minimum temp. (°C)	1	-6	-6	-9	-8	-8	-2	-2	7	8	11	3
Average temp. (°C)	14	7	4	2	3	6	9	13	19	23	24	20
Maximum humidity (%)	88	93	92	91	85	82	78	78	75	67	67	79
Minimum humidity (%)	51	48	68	45	38	36	37	33	26	25	22	29
Sunny (h)	198	191	71	176	198	214	222	276	322	369	359	293
Evaporation (mm)	115	23	---	---	---	---	84	182	260	317	284	210
Frosty (day)	---	13	15	26	22	20	6	1	---	---	---	---

Regardless of genotype, parameters of least and most, sum, average, variance, standard deviation and standard error of data were calculated for individual traits and each location (Tables 3). For trait of plant height and harvest index each city had similar values. The highest grain yield and total dry matter dedicated for Oshnavieh 1052 g/m^2 and 1990 g/m^2, respectively. In addition, traits of these genotypes in this city for variance, standard deviation and standard error parameters were higher than Orumiyeh. By examining major components of grain yield, number of grains at per spike (35.35) had more in genotypes sown in Orumiyeh. While number of spikes per square meter (715.04) was more for genotypes sown in Oshnavieh. In addition, 1000 kernel weight was in the range of 40 to 41 g at in both locations. Grain yield variability was result of the potential growing conditions in each location generated by differences in lines and its distribution during the vegetative and reproductive stages [11].

5.1 Simple analysis of variance for Urmia location

Simple analysis of variance showed that traits of plant height and 1000 kernel weight were significantly differences between genotypes ($p \leq 0.01$). The highest and lowest coefficient of variation in this location was related to harvest index and 1000 kernal weight with 23.37% and 8.44%, respectively. C-89-7 elite line and Mihan cultivar had the highest plant height with 65.27 cm and 62.55 cm, respectively. In contrast, line C-89-6 and C-89-15, with 53 cm and 52 cm were the lowest value (Table 4). 1000 kernel weight of genotypes varied between 35 to 46 g. So that 35 g and 46 g were related to elite lines of C-89-6 and C-89-7, respectively. Also 1000 kernel weight Mihan as control cultivar was 43.58 g. Nabaty and Shaban [12] examined the effects of location and lines on yield and other favorable characteristics of wheat genotypes at Aligoodarz and Dorud, Iran conditions. They selected "Homa" genotype to complimentary studies [12].

Table 2. Skewness and kurtosis of wheat traits under Urmia and Oshnavieh on-farm conditions in 2014-2015 seasons.

	Urmia Data					
Trait	Skewness	t-student value	Probability	Kurtosis	t-student value	Probability
Plant height (cm)	0.33	0.71	0.24	-0.07	-0.07	0.46
Spike length (cm)	-0.26	-0.55	0.29	0.63	0.69	0.24
Spikelet per spike	0.32	0.68	0.24	-0.7	-0.76	0.22
Grain per spike	-0.07	-0.15	0.43	-0.54	-0.58	0.28
Spike/m^2	0.54	1.16	0.12	0.09	0.10	0.45
1000-kernel weight (g)	0.16	0.34	0.36	-1.29	-1.41	0.08
Grain yield (g/m^2)	0.53	1.13	0.13	-0.34	-0.37	0.35
Total dry matter (g/m^2)	0.45	0.96	0.17	-0.11	-0.12	0.45
Harvest index (%)	-0.12	-0.27	0.39	-1.15	-1.26	0.11
	Oshnavieh Data					
Plant height (cm)	-0.15	-0.31	0.37	-0.53	-0.58	0.28
Spike length (cm)	-0.41	-0.88	0.19	-1.09	-1.19	0.12
Spikelet per spike	0.65	1.37	0.09	0.06	0.07	0.47
Grain per spike	0.72	1.53	0.06	0.13	0.14	0.44
Spike/m^2	0.06	0.13	0.44	-0.42	-0.46	0.32
1000-kernel weight (g)	-0.09	-0.20	0.42	-1.02	-1.11	0.13
Grain yield (g/m^2)	-0.50	-1.06	0.14	-1.05	-1.14	0.13
Total dry matter (g/m^2)	0.04	0.09	0.46	0.08	0.09	0.46
Harvest index (%)	-0.41	-0.88	0.19	-0.82	-0.8	0.19

Table 3. Statistical parameters of wheat traits under Urmia and Oshnavieh on-farm conditions in 2014-2015 seasons.

	Statistical Parameters of Urmia						
Trait	Minimum	Maximum	Sum	Mean	Variance	Standard error	Standard deviation
Plant height (cm)	45.0	77.5	1407.1	58.6	62.7	7.9	1.6
Spike length (cm)	5.1	8.5	165.8	6.9	0.5	0.7	0.1
Spikelet per spike	12.1	19.5	361.9	15.0	4.0	2.0	0.4
Grain per spike	27.0	45.8	848.5	35.3	25.4	5.0	1.0
Spike/m^2	341.0	873.0	13644.0	568.5	17324.5	131.6	26.8
1000 kernel weight (g)	30.3	50.5	968.0	40.3	35.5	5.9	1.2
Grain yield (g/m^2)	424.0	940.0	15986.0	666.0	19458.6	139.4	28.4
Total dry matter (g/m^2)	816.0	1880.0	30784.0	1282.6	68452.4	261.6	53.4
Harvest index (%)	34.0	70.0	1282.0	53.4	125.3	11.1	2.2
	Statistical Parameters of Oshnavieh						
Plant height (cm)	50.5	77.1	1566.6	65.2	55.7	7.4	1.5
Spike length (cm)	5.0	7.6	154.9	6.4	0.7	0.8	0.1
Spikelet per spike	10.0	17.3	324.4	13.5	3.4	1.84	0.3
Grain per spike	22.0	46.0	736.0	30.6	38.5	6.21	1.2
Spike/m^2	500.0	948.0	17161.0	715.0	13187.7	114.8	23.4
1000 kernel weight (g)	31.2	49.8	985.2	41.0	29.8	5.4	1.1
Grain yield (g/m^2)	478.0	1052.0	19641.0	818.3	30452.7	174.5	35.6
Total dry matter (g/m^2)	1118.0	1990.0	37006.0	1541.9	41282.3	203.1	41.4
Harvest index (%)	30.0	69.0	1293.0	53.8	129.8	11.3	2.3

5.2 Simple analysis of variance for Oshnavieh location

Simple analysis of variance for Oshnavieh location showed that for traits of plant height, ear length, number of spikelet at per spike, number of grain at per spike, number of spike at per square meter, 1000 kernel weight and total dry matter were statistically

Table 4. Mean comparison of wheat genotypes under Urmia on-farm conditions in 2014-2015 seasons.

Genotype	Plant Height (cm)	1000 kernel Weight (g)
C-89-6	53.99b	35.05b
C-89-7	65.27a	46.55a
C-89-15	52.70b	36.15b
Mihan	62.55a	43.58a
Means with the same letter(s) were not significant differences at 0.05 probability level		

Table 5. Mean comparison of wheat genotypes under Oshnavieh on-farm conditions in 2014-2015 seasons.

Genotype	Plant Height (cm)	Spike Length (cm)	Spikelet Per Spike	Grain Per Spike	Spike/m^2	1000 Kernel Weight (g)	Total Dry Matter (g/m^2)
C-89-6	58.46b	5.66b	12.97b	28.66b	675.16b	35.41c	1315.00b
C-89-7	71.31a	6.87a	12.24b	26.00b	696.00b	46.88a	1626.00a
C-89-15	61.76b	6.84a	15.82a	36.50a	847.00a	38.98bc	1553.66a
Mihan	69.55a	6.44ab	13.02b	31.50ab	642.00b	42.91ab	1673.00a
Means with the same letter(s) were not significant differences at 0.05 probability level							

Table 6. Bartlett's test of wheat traits under on-farm conditions at two locations in 2014-2015 seasons.

Distribute	Plant Height (cm)	Spike Length (cm)	Spikelet Per Spike	Grain Per Spike	Spike/m^2	1000 Kernel Weight (g)	Grain Yield (g/m^2)	Total Dry Matter (g/m^2)	Harvest Index (%)
Chi-square	0.19	0.34	3.63	0.02	3.60	0.03	0.14	2.09	0.68
Probability level	≤ 0.05	≤ 0.05	≤ 0.05	≤ 0.05	≤ 0.05	≤0.05	≤ 0.05	≤ 0.05	≤ 0.05

significant differences between genotypes at least $p \leq 0.05$ probability level. The most coefficient of variation allocated in grain yield and harvest index 18.83 and 18.62%, respectively. In contrast, the lowest value assigned 1000 kernel weight 8.73% and plant height 8.97%. C-89-7 promising line had the most plant height, spike length and 1000 kernel weight, 71.31 cm, 6.87 cm and 46.88 g, respectively. To traits of main components grain yield, line C-89-15 possessed maximum number of kernel at per ear (50.36 grain) and number of spike at per square meter (847 ear) and medial 1000-kernel weight. Except of C-89-6 line, other genotypes had the same amounts of total dry matter and stayed together in a statistically group (Table 5). Also, Salari et al. [15] to determine similarity and genetic distances of advanced lines divided them into three groups under Kabul, Afghanistan conditions. They found exotic lines to be adapted to the same conditions, and can be utilized in local breeding programs [14].

5.3 Bartlett's test

Before combined analyzing of variance for traits of two Urmia and Oshnavieh locations experimental error variances of them were examined by Bartlett's and Chi-square tests. After ensuring uniformity of experimental errors, combined analysis of variance was performed (Table 6). All of traits didn't show statistically significant differences and it represents uniformity of variances at two locations.

5.4 Combined analysis of variance

Combined analysis of variance revealed that excluding spike length and 1000 kernel weight had statistically significant difference at least $p \leq 0.05$ probability level at two Urmia and Oshnavieh locations. In addition, between genotypes except of grain yield and harvest index others were significantly different. The significant differences among traits of genotypes imply the presence of substantial variation among genotypes which is central to the study of traits and gives an opportunity to plant breeders for improvement of these characters through breeding. Interaction of genotype × location for any of traits showed no significant statistical differences. Lack of significant differences between impacts of genotype in location suggests that trend of variations in measured traits is uniform at two Urmia and Oshnavieh locations. As simple analysis of variance, harvest index had the highest coefficient of variation 21.11% and the least amount was devoted to 1000-kernel weight 8.59%.

Regardless of genotype, plant height, number of spike at per square meter, grain yield and total dry matter in Oshnavieh was more than Urmia location. In contrast genotypes sown in Urmia location had the highest values only for the number of spikelet at per spike and number of grains at per spike (Table 7). It seems that higher grain yield and total dry matter in Oshnavieh location than Urmia was due to favorable growth conditions for wheat that all genotypes had high grain yield. This indicated that the environmental

Table 7. Mean comparison of wheat growth locations under on-farm conditions in 2014-2015 seasons.

Location	Plant Height (cm)	Spikelet Per Spike	Grain Per Spike	Spike/m²	Grain Yield (g/m²)	Total Dry Matter (g/m²)
Urmia	58.63b	15.08a	35.35a	568.50b	666.08b	1282.66b
Oshnavieh	65.27a	13.51b	30.66b	715.04a	818.37a	1541.91a
Means with the same letter(s) were not significant differences at 0.05 probability level						

Table 8. Mean comparison of wheat genotypes under on-farm conditions in 2014-2015 seasons.

Genotype	Plant Height (cm)	Spike Length (cm)	Spikelet Per Spike	Grain Per Spike	Spike/m²	1000 Kernel Weight (g)	Total Dry Matter (g/m²)
C-89-6	56.23b	6.20b	13.73b	33.28a	631.75b	35.23c	1246.16b
C-89-7	68.29a	6.98a	13.48b	28.68b	599.50b	46.71a	1456.83a
C-89-15	57.23b	6.90a	16.02a	35.83a	747.75a	37.56c	1444.16a
Mihan	66.05a	6.63ab	13.95b	34.25a	588.08b	43.25b	1502.00a
Means with the same letter(s) were not significant differences at 0.05 probability level							

effects was large for the expression of most agro-morphological traits which also supported by Sbhashchandra et al. [16].

5.5 Mean comparison of genotypes

Promising line of C-89-15 was higher spike length (6.9 cm), number of spikelet at per spike (16.02), number of grain at per spike (35.83), number of spike at per square meter (747.75) and total dry matter (1444.16 g/m²) than the other genotypes. In contrast this genotype had lower grain weight. It seems that there is a negative relationship between main yield components. By increasing one of them other component is reduced. Promising line of C-89-7 had the highest 1000 kernel weight (46.71 g) but for other main yield components like number of ear at per square meter (599.50) and number of grain at per spike (28.68) was in lower rank. Among evaluated four genotypes, only promising line C-89-6 had low dry matter and separately located in lower rank. While two other promising lines C-89-7 and C-89-15 assigned with Mihan as control and had high total dry matter. In terms of plant height genotypes were classified into two groups. So that two lines of C-89-6 and C-89-15 had 56 and 57cm height and together were the same group and C-89-7 with Mihan as control cultivar characterized in higher group with 66 and 68 cm plant height, respectively (Table 8). These two genotypes were more total dry matter than C-89-6 line due to higher plant height. Logging and fungal diseases caused by it and had an important role in reducing grain yield. Genotypes with higher grain yield have shorter plant height. Improved cultivars have possessed shorter height than old varieties and acceptable for consuming to use chemical fertilizers. Dwarf cultivars stored photosynthetic assimilates as a source in grain. Tahmasebi et al. [17] with assessing genetic diversity and interrelationship of traits in some promising wheat lines and determine the traits effective on grain yield observed high genotypic and phenotypic coefficient variations for traits of grain yield, number of spike and 1000 kernel weight. Plant height, number of spike and 1000 kernel weight had significantly positive relationship with grain yield [17]. Information on diversity and relationship among the agro-morphological traits will be helpful to breeders in constructing their breeding populations or lines and implementing selection strategies.

5.6 Characteristics of promising lines

From C-89-6 Minimum and maximum grain yield that were harvested was 424 and 924 with an average 668.66 g/m² (Table 9). For line C-89-7 with average grain yield 637 g/m², line C-89-15 on the amount of 817.5 g/m² and Mihan cultivar produced 731.66 g/m² grain yield. Similar results are further supported by Longove et al. [7] who reported considerable variations in grain yield of promising wheat lines when planted under agro-ecological conditions of Quetta, Pakistan. As regards there was not significant differences among grain yield of genotypes at combined analysis of variance, line C-89-15 produced maximum grain yield than compared with other lines and cultivar. It seems that higher grain yield in C-89-15 was due to higher spike length, number of spikelet at per spike, grain per spike and number of spike at per square meter. Finally, one thousand spikes provided for producing breeder seed. Farmers in developing countries which use no or limited inputs and grow cereals under marginal and unpredictable environments, require promising varieties. In theses cases, genotypes with good performance should be recommended.

After harvesting total of the field, grain yield of the genotypes weighed separately at each city (Table 9). C-89-6 to C-89-15 and Mihan cultivar in Urmia location were 6.5, 6.5, 7.5 and 7.0 ton/ha grain yield and in Oshnavieh location were 7.5, 7.5, 8.0 and 8.0 ton/ha, respectively. Moayedi and Azizi [9] in studying improvement of knowledge and skills level of wheat-cultivating farmers using on-farm researches concluded that the new selected promising lines are able to increase income and productivity of farmers. Also, our farmers with sowing new cultivar arises economic level of family.

Table 9. Statistical parameters of promising lines and control cultivar at two locations under on-farm conditions in 2014-2015 seasons.

	C-89-6 Promising Line						
Trait	**Minimum**	**Maximum**	**Sum**	**Mean**	**Variance**	**Standard error**	**Standard deviation**
Plant height (cm)	49.83	65.33	674.79	56.23	28.41	5.33	1.53
Spike length (cm)	5.00	7.50	74.43	6.20	0.77	0.87	0.25
Spikelet per spike	11.50	16.83	164.80	13.73	2.70	1.64	0.47
Grain per spike	23.00	45.84	399.36	33.28	47.49	6.89	1.98
Spike/m^2	407.00	873.00	7581.00	631.75	20503.11	143.18	41.33
1000-kernel weight (g)	30.30	39.70	422.80	35.23	10.07	3.17	0.91
Grain yield (g/m^2)	424.00	924.00	8024.00	668.66	19683.15	140.29	40.50
Total dry matter (g/m^2)	938.00	1520.00	14954.00	1246.16	24246.87	155.71	44.95
Harvest index (%)	37.00	69.00	649.00	54.08	88.44	9.40	2.71
	C-89-7 Promising Line						
Plant height (cm)	71.50	77.5	149.00	74.50	18.00	4.24	3.00
Spike length (cm)	6.66	8.58	15.24	7.62	1.84	1.35	0.96
Spikelet per spike	12.66	17.33	29.99	14.99	10.90	3.30	2.33
Grain per spike	31.50	35.50	67.00	33.50	8.00	2.82	2.00
Spike/m^2	515.00	538.00	1053.00	526.50	264.50	16.26	11.50
1000-kernel weight (g)	47.40	47.90	95.30	47.65	0.12	0.35	0.25
Grain yield (g/m^2)	592.00	682.00	1274.00	637.00	4050.00	63.64	45.00
Total dry matter (g/m^2)	1262.00	1682.00	2944.00	1472.00	88200.00	296.98	210.00
Harvest index (%)	41.00	47.00	88.00	44.00	18.00	4.24	3.00
	C-89-15 Promising Line						
Plant height (cm)	45.00	66.50	686.80	57.23	54.76	7.40	2.13
Spike length (cm)	5.16	7.58	82.84	6.90	0.45	0.67	0.19
Spikelet per spike	12.16	19.50	192.28	16.02	4.48	2.11	0.61
Grain per spike	27.00	42.00	430.00	35.83	24.51	4.95	1.42
Spike/m^2	467.00	948.00	8973.00	747.75	21046.75	145.07	41.88
1000-kernel weight (g)	32.70	43.10	450.80	37.56	7.32	2.70	0.78
Grain yield (g/m^2)	506.00	1052.00	9810.00	817.50	39380.45	198.44	57.28
Total dry matter (g/m^2)	1050.00	1674.00	17330.00	1444.16	43814.87	209.32	60.42
Harvest index (%)	41.00	69.00	681.00	56.75	101.84	10.09	2.91
	Mihan as Control Cultivar						
Plant height (cm)	58.33	76.66	79.64	66.05	27.70	5.26	1.51
Spike length (cm)	5.66	7.50	79.63	6.63	0.38	0.62	0.18
Spikelet per spike	11.66	16.00	167.45	13.95	2.20	1.48	0.42
Grain per spike	26.00	46.00	411.00	34.25	36.93	6.07	1.75
Spike/m^2	411.00	700.00	7057.00	588.08	8344.81	91.35	26.37
1000 kernel weight (g)	34.50	48.10	519.00	43.25	20.05	4.47	1.29
Grain yield (g/m^2)	478.00	992.00	8780.00	731.66	32898.06	181.37	52.35
Total dry matter (g/m^2)	946.00	1880.00	18024.00	1502.00	87793.63	296.30	85.53
Harvest index (%)	30.00	67.00	604.00	50.33	178.42	13.35	3.85

6. Conclusion

Wheat breeders should try to select the new cultivars and lines responsive to the environmental changes for improving grain yield and yield components. Most of new high yielding varieties have been selected under on-station research conditions. However on-farm research can help the research and development process. The highest grain yield accounted to C-89-15 promising line. With regard to other factors such as disease resistance, especially yellow and brown rust and tolerant to low irrigation, mentioned line shall be replaced by old and conventional cultivars such as Mihan, Urum, Zare, Pishgam and Zarrin in the wheat lands of west Azerbaijan province. One thousand spikes of C-89-15 were selected for propagating breeder seed Distributions of it between wheat farmers.

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