

Durum Wheat Land_Race Screening for Drought Tolerance

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Abstract: In this experiment 15 durum wheat (*Triticum durum* L.) genotypes were selected from North West of Iran and Azerbaijan and planted in two different irrigated and non-irrigated conditions in Ardebil region in a RCBD trail with 4 replications. The ANOVA results showed that there were significant differences among genotypes and genotypes×drought interaction in all agronomic and morphologic attributes ($P=0.01$). For study the relative drought tolerance of genotypes, the Fernandez Stress Tolerance Index (STi) were calculated by mean of the data in irrigated and non-irrigated conditions. Among the genotypes the Naxcivan-2 landrace, Xanlar and Naxcivan-1 were most tolerant and the two first had higher harvest index also. By the cluster analysis of the STi, the genotypes were divided in three groups. The Naxcivan-2 landrace and Xanlar had showed not only the higher tolerance index (STi) but also the higher kernel and seeds weight per spike. In the other hand, There was an adaptation between cluster and stress tolerance index.

Key words: Durum wheat • Drought tolerance • Screening

INTRODUCTION

Dryness of the most important factor limiting production of crops including wheat in the world and Iran. This Topic is more important in dry and semi-arid regions of the world [1]. Importance of this subject is determined when we know which more than 1/4 part ground is dry and estimated that about 1/3 of the world's cultivable land under water shortage conditions are in range [1]. Wheat production in Mediterranean region is often limited by sub-optimal moisture conditions. Visible syndromes of plant exposure to drought in the vegetative phase are leaf wilting, a decrease in plant height, number and area of leaves and delay in accuracy of buds and flowers [2]. Drought tolerance consists of ability of crop to growth and production under water deficit conditions. A long term drought stress effects on plant metabolic reactions associates with, plant growth stage, water storage capacity of soil and physiological aspects of plant. Drought tolerance in crop plants is different from wild plants. In case crop plant encounters severe water deficit, it dies or seriously loses yield while in wild plants their surviving under this conditions but no yield loss, is taken into consideration. However, because of water deficit in most arid regions, crop plants resistance against drought, has always been of great importance and has taken into

account as one of the breeding factors [3]. Achieving a genetic increase in yield under these environments has been recognized to be a difficult challenge for plant breeders while progress in yield grain has been much higher in favorable environments [4]. Thus, drought indices which provide a measure of drought based on yield loss under drought conditions in comparison to normal conditions have been used for screening drought-tolerant genotypes [5]. These indices are either based on drought resistance or susceptibility of genotypes [6]. Zaeifzadeh and Goliov [7] studied the relationship between genotype and environmental conditions (dry and normal) on the amount of chlorophyll content and the amount of super oxide Dismutase reported that drought-resistant cultivars increase Dismutase Super oxide stress increases but in susceptible cultivars decrease chlorophyll Super oxide Dismutase showed. Also a good variety between the native masses of durum wheat in North-West Iran and Azerbaijan in terms of drought resistance and SRAP (Sequence related amplified polymorphism) but did not found any Significant relationship between Coefficient of drought tolerance and SRAP. The purpose of this study tolerance of durum wheat landraces and the amount of variation between them tolerable to drought and resistant genotypes are selected.

Table 1: List of genotypes used in project

No	Sub convar	Region	
1	Leucurum	Xanlar	(Az)
2	Braktli 95		(Az)
3	Melanopus	ahar	(IR)
4	Simare		(IR)
5	Africanum	Sanandaj	(IR)
6	Africanum	Nakhjavan	(Az)
7	Leucurum	khachmaz	(Az)
8	Leucomelan	Nakhjavan 2	(Az)
9	Melanopus	Hassan-Barrog	(IR)
10	Erythromelan	Shamakhi	(Az)
11	Hordeform	Sahand	(IR)
12	Boeuffii	Langan	(IR)
13	Hordeform	Langan	(IR)
14	Apulicum	Ardabil	(IR)
15	Leucomelan	Nakhjavan 1	(Az)

- Azerbaijan

- Iran

MATERIALS AND METHODS

The study was conducted with 15 durum wheat genotypes, from Iran and Azerbaijan origin, in a randomized complete block design in four replicates in water and dry condition in the Agricultural Research Station, Islamic Azad University, located at 5 km north of Ardebil, in 2008-2009. The studied genotypes are in Table 1. In order to study the diversity among different genotypes traits were measured such as thousand kernel weight, total number of tillers, fertile tillers, plant height,

internode numbers, peduncle length, grain weight per main spike, plant dry weight and Main spike weight. For evaluation stress tolerance among studied lines, (STI) stress tolerance index according to Fernandez [6] was used:

Stress Tolerance Index (STI):

$$STI = (Y_{pi} \times Y_{si}) / Y_p^2$$

Y_{si} = yield of cultivar in stress condition,

Y_{pi} = yield of cultivar in normal condition

Y_p = total yield mean in normal condition

For clustering UPGMA method was performed. MATATC and SPSS software was used for analysis of data.

RESULTS AND DISCUSSION

List of genotypes used in the experiments in Table 1. Combined analysis of studied data in both conditions showed that differences between conditions with and without drought stress in terms of plant height, peduncle length, length of main spike, spike weight, total awn, total plant weight, grains per main spike, grain weight per main spike, spike weight, the plot performance, plot total weight, straw weight, harvest index, thousand kernel weight and grain ratio in spikelet, but traits as total number of tillers, fertile tillers, fertile tillers rate to total tillers and number of internodes was not significant (Table 2).

Table 2: The analysis of variation for durum wheat land race under drought stress treatments

MS											
S.O.V	df	Total Weight	1000 grains weight	Own	Spike weight	Spike length	Peduncle length	Node No.	Fertile Tillers No.	Fertile Tillers No.	Total tillers No.
Drought Stress (S)	2	3880.83 **	72.624*	16.785**	11.992 **	12.686**	905.066**	0.202 ^{ns}	0.006430 ^{ns}	3.843 ^{ns}	4.085 ^{ns}
Replication×											
Conditio (R×S)	3	550.229 ^{ns}	7.012 ^{ns}	8.123**	1.818 **	6.750**	165.689*	0.338 ^{ns}	0.07792 ^{ns}	11.561 ^{ns}	40.619**
Genotype (G)	14	148.317 ^{ns}	35.161*	3.610*	0.960**	2.464*	104.848*	0.443*	0.03237 ^{ns}	7.873 ^{ns}	9.083 ^{ns}
S × G	28	168.898 ^{ns}	35.913 **	2.686 ^{ns}	0.431 ^{ns}	1.992 ^{ns}	138.009**	0.342 ^{ns}	0.02495 ^{ns}	4.139 ^{ns}	5.865 ^{ns}
Error	42	202.146	14.881	1.734	0.354	1.261	46.444	0.228	0.03062	6.148	9.137

Table continued

MS											
S.O.V	df	Height	HI	Straw weight	Total weight per Plot	Yield (plot)	Spikes weight	Seed weight per spike	Density	Spike seeds No.	Spikelet seeds ratio
Drought Stress(S)	2	3120.24 **	1343.9**	194947.6**	753150.85 **	194438.49**	603.252**	8.342**	15.122**	2029.507 **	0.659*
Replication×											
Conditio (R×S)	3	256.313 ^{ns}	85.580 ^{ns}	16314.95 ^{ns}	25144.339 ^{ns}	1180.784 ^{ns}	55.446 ^{ns}	2.539**	3.858**	395.465**	0.292 ^{ns}
Genotype (G)	14	332.749*	125.92**	20062.666 ^{ns}	40261.556 ^{ns}	7927.459*	80.844 ^{ns}	0.688 ^{ns}	4.131 **	115.848 ^{ns}	0.139 ^{ns}
S × G	28	585.133 **	63.082 ^{ns}	8372.439 ^{ns}	19269.230 ^{ns}	3890.532 ^{ns}	53.684 ^{ns}	0.372 ^{ns}	0.811 ^{ns}	36.426 ^{ns}	0.188 ^{ns}
Error	42	169.237	45.367	12673.318	0.354	371.443	53.861	0.530	0.831	66.600	0.155

** And * significant at the 0.01 and 0.05 levels, respectively

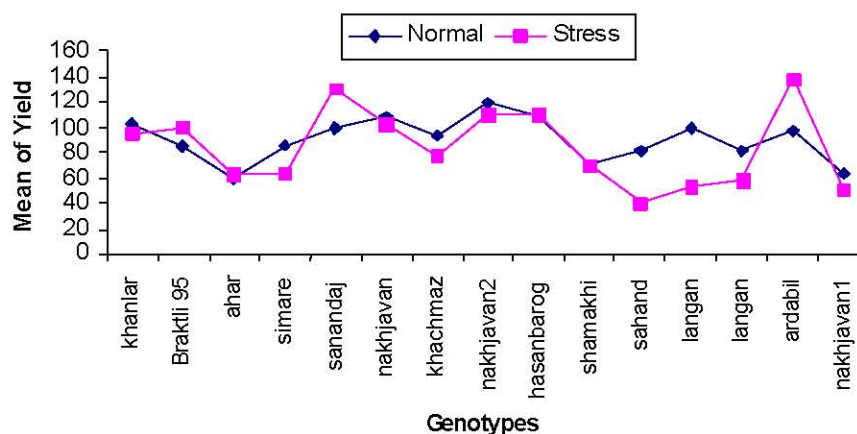


Fig. 1: Comparison of average performance for the genotypes evaluated under drought stress conditions and water

Table 3: Yield in normal and dry condition

Genotypes	Sti- Yield	Yield in drought condition	Yield in normal condition
Xanlar	1.28	95.5	102.35
Barakatli 95	0.8	99.5	84
Ahar	0.68	62.9	58.55
Simare	1.1	63.7	85.65
Sanandaj	0.82	130.3	99.25
Nakhjavan	1.15	101.9	108.5
Khachmaz	0.74	76.9	93.95
nakhjavan2	1.36	109.95	118.05
Hasanbarog	0.78	109.75	107.6
Shamakhi	0.6	69.5	69.1
Sahand	1.01	39.95	82.15
Langan	0.57	53.6	98.85
Langan	0.6	57.35	81.45
Ardabil	0.49	137.65	96.05
nakhjavan1	1.32	50.65	63.3

Genotypes in terms of main spike weight, density and harvest index, plant height, internodes number, peduncle length, length of main spike, awn length, thousand kernel weight and plot yield were significant (Table 2), which indicates the richness of genetic diversity. The mean performance of genotypes shows that genotype Nakhchivan2, Hassan-Barrog, Ardebil and Sanandaj had the highest performance due to high grain number and weight.

The interaction between genotype and condition indicated that all traits had significant difference except plant height, peduncle length and thousand kernel weight. Therefore, the selection of genotypes based on independent characters of the environment is possible and interaction should be examined.

Sanandaj genotypes in dry conditions had more yield than water conditions but average performance of genotypes in water conditions was significantly higher than dry conditions. In most genotypes with stress,

performance decreased but in genotypes of Ardabil, Barakatly-95 and Sanandaj has increasing trend and this issue is causing significant interaction. In order to assess genotypes drought tolerance, average performance of genotypes in the two conditions used to calculate in Fernandez method and are listed in Table 3.

Nakhichevan 2 (Leucomelan), Khanlar (Leucurum) and Nakhchivan 1 (Leucomelon) land races showed the highest drought tolerance index. Among these genotypes, Nakhchivan-2 (Leucomelan) and Khanlar (Leucurum) landraces had the highest tolerance. in harvest index also.

Grouping genotypes based on Fernandez Tolerance Index (STi) using cluster analysis showed that the genotypes evaluated in three categories in which genotypes Nakhchivan-2 (Leucomelan) and Khanlar (Leucurum) in terms of indicators of high tolerance and due to number of grains per spike and weight were most tolerant. In other words, the cluster scheme was compatible with genotypic drought tolerance (Figure 1).

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