

Classifying Bread Wheat Genotypes by Multivariable Statistical Analysis to Achieve High Yield under after Anthesis Drought

¹Vahid Mollasadeghi, ²Ali Akbar Imani, ²Reza Shahryari and ¹Majid Khayatnezhad

¹Young Researchers Club, Ardabil Branch, Islamic Azad University, Ardabil, Iran

²Department of Agronomy and Breeding, Ardabil Branch, Islamic Azad University, Ardabil, Iran

Abstract: In order to classify bread wheat genotypes and existing relations among agronomic traits for grain yield under drought condition after anthesis, eight bread wheat genotypes had been planted and evaluated in the form of factorial split plot on the basis of completely randomized block design in three replications at the Research Farm of Islamic Azad university, Ardabil branch in 2008-2009 farming year. Under-study traits were plant height, number of fertile tillers, number of sterile tillers, spike length, spike weight, number of grain per spike, 1000 grain weight, biological yield, straw yield, harvest index and grain yield. The results of step by step regression showed that traits including harvest index and biological yield had justified approximately 99.57% of grain yield variations under drought stress condition. In the factor analysis, three hidden factors had been identified which they totally had justified 88 percent of totally data variation. These factors associated with yield potential, harvest index and phenological factor. The cluster analysis of data was placed genotypes on two groups. Comparison of traits average in the given groups showed that existing genotypes in the first group have the most rate of the number of sterile tillers, spike length, spike weight, 1000 grain weight, biological yield, straw yield, harvest index and grain yield, which they can be utilized in breeding programs under after anthesis drought condition.

Key words: Bread wheat • Drought stress • Step by step regression • Factor analysis • Cluster analysis

INTRODUCTION

Population growth phenomenon in the developing countries and food diversity and also food high consumption in the developed countries lead to increasing global demand on food, so that this is not so happened so far. Wheat with the scientific name *Triticum aestivum* is the most important crop in the world and planting in the extensive area of environmental conditions in the world and also it produces about 20 percent food resources of the world people. One of the most important factors that reduce wheat production in the dry and semidry areas is drought. In these areas the most important limitations of wheat growth are lack of irrigation water and humidity in the different stages of plant growth. Improvement and development of yield of wheat varieties under drought condition in such areas are the most important breeding programs [1]. So, morphological and agronomic traits of wheat has a special role to determine importance of each trait on increasing yield, as well as to use those traits at the breeding programs, which at last

lead to improving yield and introducing commercial varieties under end seasonal drought stress condition [2]. In these areas some farmers do not achieve optimal result during cultivation of varieties which are promising to irrigation and this is due to lack of sufficient water in spring or not sufficient irrigation due to watering of summer crops in end of season and consequently wheat culture suffers from drought stress after anthesis [3].

We can omit ineffective or low-effective traits on yield in the regression model with the aid of stage regression analysis and we can just evaluate traits which had justified yield alterations significantly [4]. We can also analyze genetic diversity on the basis of morphological and biochemical data by multivariable statistical methods which considering several measurements, simultaneously. Of statistical different methods in multivariable analysis, principal components analysis, factor analysis and cluster analysis are important ones [5]. We can explain correlation between many variables in the form of a few independent factors by

statistical method of factor analysis [6]. We can measure relationships and plant materials by cluster analysis. This method is genetically and environmentally suitable in hybridization for classifying under-study varieties of the plant, as well as to determine parents [7]. Leila and Al-Khateeb [8] had identified three hidden factors to evaluate effective factors of wheat grain under drought stress condition, which it was justified 74.4 percent total variation. First factor includes number of spike in square meter, 1000 thousand grain weight, grain weight per spike and biological yield which justified 26.6 percent data variation. Mohammadi [9] had been divided 16 under-study genotypes at 11 separate groups in evaluating 16 bread wheat and durum wheat genotypes under drought stress condition by cluster analysis.

The purpose of this investigation was to evaluate genetic diversity of bread wheat and to determine relationships between different traits under end seasonal drought stress and to identify effective factors on genetic improvement and drought tolerance of bread wheat genotypes.

MATERIALS AND METHODS

In order to evaluate genetic diversity of bread wheat genotypes under after anthesis drought stress condition, eight genotypes including Sabalan, Ruzi-84, Gubustan, Mv 17/zrn, Sardari, 4041, Saysonz and Toos were planted in the Research Farm of Islamic Azad university, Ardabil branch in the experiment of factorial split plot on the basis of completely randomized block design in three replications in 2008-2009 agricultural year. The rainfall was 242.3 mm during agricultural season, the minimum of temperature was -1.5°C in November and the maximum of temperature was 25.01°C in May. Each experimental plot includes three rows at a distance of 20 cm with each other and with three meters in length. Dimensions of each experimental plot were 3×7 square meter. Consumption seed rate was on the basis of considering 1000 grain weight about each variety and also 450 seeds in each square meter. There was no two times irrigation for drought treatments in the relevant alterations after anthesis. Under-study traits in this experiment include plant height, number of fertile tillers, number of sterile tillers, spike length, spike weight, number of grain per spike, 1000 grain weight, biological yield, straw yield, harvest index and grain yield. The performed statistical analysis including step by step regression analysis, factor analysis used principal components analysis and cluster

analysis by Ward method use of standardized means. For this purpose, software's Minitab-15 and SPSS were used.

RESULTS AND DISCUSSION

Relation between grain yield and its components is complex and obviously some traits had justified better grain yield alterations than other traits. Table 1 shows estimation of grain yield in respect of role of other traits under end seasonal drought stress condition in the way of step by step regression. According to achieved results, the biological yield is the most important trait which has a close relation with grain yield and it has justified 79.77 percent its alteration by itself. After biological yield the harvest index entered to regression model and at last these two variables had justified 99.57 percent grain yield alteration. These results were similar with Naderi *et al.* [10] and Hosseinpour *et al.* [11] which in both research, traits of biological yield and harvest index had justified some grain yield alterations, so that these results are not compatible with Ali *et al.* [12].

Factor analysis under end seasonal drought showed that three first factor had justified 88.15 percent existing alterations among traits, as a whole (Table 2). First factor set aside 41.009 percent variance between traits to itself it has an important role to justify alteration of spike weight, number of grain per spike, biological yield and grain yield. So, this factor called as yield potential factor (Table 3). If the selection had complemented on the basis of first factor under after anthesis drought stress environment, this selection will has the most effectiveness in the grain yield. These results are compatible with Golabadi and Arzani [13]. Second factor had justified 31.165 percent variance and factorial coefficients of traits of plant height, straw yield and 1000 grain weight and harvest index had most effectiveness and therefore this factor called as effective factor to increasing harvest index. In small grain cereals, increasing of harvest index may cause to improving yield under drought stress without increasing necessity to water [14].

The harvest index as a quantitative trait indicating plant efficiency to distribute dry matter for grain and it is one of the main purposes at the breeding programs of cereals, which introduced genotypes with high harvest index [15]. In the third factor that had justified 15.972 percent alterations, the factorial coefficients related to number of fertile tillers and spike length is high and positive. So, it can be called as phenological factor (Table 3).

Table 1: Step by step regression analysis for grain yield and agronomic traits in bread wheat genotypes under after anthesis drought stress conditions

Stage	Equations	R ²	Standardized Coefficients			
		Model	Beta	t	sig	VIF
1	Yg = 0.584+2.694BY	0.798	1.105	60.652	0.000	1.123
2	Yg = -2.864 + 3.174BY + 0.062HI	0.996	0.458	25.130	0.000	1.123

Yg : Grain yield; BY: Biological yield; HI: Harvest index

Table 2: Special values, variance percent and association percent of variance in the extracted factors under drought stress conditions after anthesis

Factor	Special amounts	Variance percent	Cumulative variance percent
1	4.511	41.009	41.009
2	3.428	31.165	72.174
3	1.757	15.972	88.146

Table 3: Factor analysis for under-study traits via principal components under after anthesis drought

traits	First factor	Second factor	Third factor
Plant height	-0.49	0.714	-0.005
Fertile tillers number	-0.629	-0.103	0.731
Unfertile tillers number	0.688	0.349	0.288
Spike length	0.331	0.389	0.806
Spike weight	0.813	-0.423	0.152
Seed number per spike	0.772	-0.592	-0.02
1000 grain weight	-0.698	0.593	0.333
Biological yield	0.725	0.623	0.002
Straw yield	0.568	0.771	-0.167
Harvest index	0.03	-0.822	0.520
Grain yield	0.824	0.308	0.240

Table 4: Comparison among traits for achieved groups form cluster analysis of 8 bread wheat genotypes under drought on the basis of agronomic traits

Traits	Mean	
	Group 1	Group 2
Plant height	64.53 b	71.14 a
Fertile tillers number	19.17 b	20.50 a
Unfertile tillers number	5.75 a	4.42 b
Spike length	7.77 a	7.25 b
Spike weight	1.69 a	1.35 b
Seed number per spike	30.28 a	23.53 b
1000 grain weight	51.90 b	59.22 a
Biological yield	7.16 a	6.14 b
Straw yield	0.517 a	0.458 b
Harvest index	48.86 a	46.95 b
Grain yield	3.47 a	2.86 b

Differences between averages of each column which have common characters are not significant at probability level of 5%.

Achieved dendrogram from cluster analysis of 8 genotypes on the basis of 11 agronomic traits. According to this grouping, under-study wheat

genotypes divided to two groups. Table 4 shows characters of each group of genotypes, as well as it had presented means of two dendrogram groups. Genotypes of first group include Toos, 4041, MV17/Zrn and Sabalan. Existing genotypes in this group are in average in respect of number of sterile tillers, spike length, spike weight, biological yield, straw yield, harvest index and grain yield, but they are in the high rate in respect of number of grain per spike and these results are similar with Soleimani Fard *et al.* [16]. While the genotypes in this group are in the high rate in respect of number of grain per spike, but this yield component could not increase bread wheat yield under drought stress condition. Second group comprises 4 genotypes including Ruzi-84, Saysonz, Gobustan and Sardari. Genotypes in this group are in the high rate in respect of plant height, number of fertile tillers and 1000 grain weight and they are in the lowest level of desirability for other traits and can not be selected. Crossing among existing genotypes in first and second groups provided more possibility to having more genetic variance and optimal genotypes in respect of yield performance under drought and this is due to multiplicity of grain number per

spike in the first group and existing genotypes in second group which had the most plant height, number of fertile tillers and 1000 grain weight. Achieved results of this project showed that in order to introduce varieties which have high yield under end seasonal drought stress, it is possible crossing between above mentioned two groups of genotypes.

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