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Factor Analysis of Wheat Quantitative Traits on Yield under Terminal Drought

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Abstract: An investigation was performed in order to research about all together relations of some quantitative traits with wheat grain yield under end drought stress in factorial split plot on the basis of completely randomized block design in 3 replications at Research Farm of Islamic Azad University, Ardabil branch in 2008-2009 farming year. The first factor was irrigations levels and the secondary one is related to genotypes. Factor analysis determined four hidden factors by extraction of static roots and also by principal components analysis which justified 83.51 percent of data variation as a whole. The first factor with the most percent of justified variance of data was called effective factor to yield. The second factor with the most factor coefficients belongs to effective traits to spike characteristics. The third factor which has extensive and positive coefficients for plant height, peduncle length and internodes weight, was called the effective factor to plant height. The forth factor with the most factorial load over traits such as number of fertile tiller, spike and peduncle length was called as effective factor to plant growth.

Key words: *Triticum aestivum* · Drought · Quantity · Hidden factors

INTRODUCTION

Wheat is the most important agriculture goods in international market and also it is one of the strategic agricultural productions which have daily and universal consumption [1]. One of the important problems in dry and semidry areas is less of irrigation water [2]. Occurrence of continuous droughts in 2007-2008 farming year influenced extensive area of the country, sound the repeated alarm to agriculture goods and production stability. Therefore, it should be more notes to stable strategies for all of research and operation fields to reduce effects of this natural phenomenon. Of the years in which effect of this phenomenon over different dry and even irrigated farming productions was evident as well, the most obvious year was 2007-2008 [3]. On the other hand, the wheat consumption was increased during the 10 recent years (2000-2010) with respect to climatic changes and their effect to farming and increasing world population. The wheat production under irrigated conditions will reduce to 30 percent by 2050, while the population will be double.

Since there are negative correlations between yield related traits, with respect to complex relations of traits with each other, the last judgment cannot be performed only on the basis of simple correlation coefficients, but it is essential to utilize multivariable statistical methods to comprehend relations between traits deeply. Multivariable analysis like stage regression and factor analysis is used to explain existing relations between traits and to group them on the basis of these relations. So, in this way the most important traits influencing yield and also hidden factors are identified which result in appearing particular structure of covariance matrix among traits and variables which have the most intergroup correlation and show the minimum correlation to other groups. consequently, it can improve different traits simultaneously, which influenced by different factors and in order to achieve ideal yield, we can strengthen or weaken one or more hidden factors be hopeful that traits influenced by each one of the hidden factors, will never suffer from doubt by changing other factors or at least, these changes are not very much [4]. Factor analysis is used to reduce number of variables into some hidden factors, as well as to identify principal components of the yield, to classify traits on the basis of intra-relations between them and to research genetic diversity. So factor analysis can be complementary of stage regression analysis and path coefficient analysis and presents additional information [5]. The present study was performed to determine most effective traits to improve wheat genotypes yield under drought stress condition in end of season.

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MATERIALS AND METHODS

In order to evaluate effective quantitative traits to bread wheat yield under drought condition in end of season in Ardabil, 9 genotypes were prepared from Agriculture and Natural Resources Research Center of Ardabil, as well as 3 genotypes from Azerbaijan. Investigation was located at Research Farm of the Islamic Azad University, Ardabil branch according to 1000 seed weight and 450 grain wheat in square meter. Factorial split plot experiment was conducted on the basis of completely randomized block design in three replications. The first factor was irrigation levels and secondary was related to genotypes. According to aerologic traits the rainfall was 3.242 mm during agricultural season, the minimum temperature was -5.1°C at November and the maximum temperature was 01.25°C at May [6]. There was no repeated irrigation for drought experiment after anthesis. Under-study traits in this project include plant height, number of fertile tillers, spike length, spike weight, grain weight in spike, 1000 grain weight, peduncle length, number of internodes, internodes weight, awn length, biological yield, straw yield, harvest index and grain yield. We used from soft wares like MSTAT-C and SPSS_16 for statistical analysis. Factor analysis was performed by varimax factorial rotation via Kaiser Criteria.

RESULTS AND DISCUSSION

Factor analysis was used to evaluate and comprehend complex relations of traits, as well as to identify hidden factors. This analysis performed for the measured traits by principal components in the stress conditions and then the factors rotation performed by varimax rotation. Factor analysis complemented on the basis of special values which are larger than one and was done by considering four factors (Table 1). These four factors justified 83.51 percent data variation, as a whole. It is essential to say that achieved KMO (Kaiser Meyer Oltin) values and also significance of Bartlett Asphersity test refers to be sufficient of correlation values of first variables to do factor analysis. Selection for factors number was on the basis of roots number larger than 1 and the number of used primary variables in factor analysis was equal to 14, according to formula F< (P+1)/2(in which P and F refer to number of variables and number of factors, respectively) selection of four factors for stress conditions is compatible with the presented principles [7]. Traits placed which on the subdivision of a factor with similar sign, all of them influenced by an unknown nature in similar direction. Each factor has not individual existence, but it is resultant of processes and characteristics which influenced by those traits [8]. Four factors justified 83.5 percent changes among traits, as a whole (Table 1). Community rate in majority of traits was high and selected factors can optimally justified alternations of traits. Share of each factor from first to fourth is 26.9, 22.9, 22.2 and 11.6 percent, respectively. Factor analysis results show that first factor has large and positive factorial coefficients for traits like awn length, biological yield, straw weight and grain yield and it can be called effective factor to yield. The second factor has large and positive coefficients for spike weight and grain weight per spike and it can be called effective factor to spike characteristics. The third factor has large and positive coefficientsfor plant height, peduncle length and internodes weight and it can be called effective factor to plant height. According to previous evaluations, the tall varieties have better drought tolerance and they produced higher yield. Sio-se Mardeh *et al*. [9] called tall varieties as an optimal trait under drought condition. In fourth factor, the most factor coefficients related to the number of fertile tiller, spike length and peduncle length and it can be called as plant growth factor. Walton [10] used factor analysis to identify growth and morphological traits relevant to yield in spring wheat and they introduced four factors which include yield components, morphological traits, spike

Table 1: Factor analysis by principal components using varimax rotation

	Components				
Traits	1	2	3	4	Communalities
Plant height	-.085	-.488	.773	.357	.97
Fertile tillers number	-.112	-.239	.133	.837	.97
Spike length	-595	-431	-.209	-552	.89
Spike weight	-286	-926	-.163	-.116	.98
Seed number per spike	-216	-938	-.173	-.031	-96
1000 Seed weight	-.360	-.474	-.130	-217	-42
Peduncle length	-.269	-.194	-619	-588	-84
Number of inter node	-318	-.670	-432	-197	-78
Internode weight	-.029	-126	-954	-003	-93
Awn length	-690	-003	-.19	-048	-51
Biological yield	-950	-178	-.001	-.113	-95
Straw weight	-895	-103	-231	-.106	-88
Harvest index	-068	-412	-.867	-029	-93
Grain yield	-881	-213	-.229	-.098	-88
% of Variance	26.912	12.876	22.176	11.548	
Cummulative %	26.912	49.788	71.964	83.513	
Total	3.768	3.203	3.105	1.617	

length and number of grain per plant, as well as relation of large grains and grain filling duration with high yield. Tousi Mojarad *et al*. [7] introduced five factors by complementation of factor analysis via principal components analysis which they justified 67.7 percent of data variations as a whole.

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