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Study of correlation among yield and yield components affecting traits on bread wheat under drought stress and non-stress conditions

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ABSTRACT

In order to investigate affecting traits on yield and yield components, five wheat genotypes in a completely randomized block design with three replications were evaluated. The experiment was repeated in two normal irrigation and drought stress levels. In this experiment, traits such as tiller number, plant height, number of grains per spike, grain weight, and number of stomata in leaf, ash content and yield were investigated. Drought stress reduced the grain yield and its components in all genotypes. Average yield was significantly decreased under drought stress. MV17 genotype with an average of 102.40 kg per hectare got the maximum and Gaspard genotype with an average of 80.15 kg per hectare, got the minimum grain yield and also in drought conditions Azar2 genotype with an average of 79.10 kg per hectare got the maximum and with an Gaspard genotype with an average of 34.83 kilograms per hectare, got the minimum value among all studied genotypes. Analysis of grain yield correlation with its components demonstrated that in normal irrigation conditions, number of grains per spike and ash content was most correlated with grain yield, however, in drought stress conditions correlation between plant height and one thousands grain weight was a meaningful positive relation and number of stomata in leaf area had a meaningful negative relation. Therefore one can select the genotypes, in normal irrigation and stress condition, using traits which have high correlations with grain yield to improve the grain yield. Hence one can take plant height, grain weight and number of stomata in leaf as the criterion of superior genotype selection in end season draught tolerance.

Keywords: Wheat, Draught Stress, Grain yield, Correlation

INTRODUCTION

Wheat is cultivated in wide areas of the world in a range of latitude 67 degrees north (Norway, Finland and Russia) to 45 degrees South latitude (in Argentina) [1]. Wheat, will supply over 20% of calories needed to the world's population [2]. In Iran wheat is as a major source of supply of needed calories and protein for the population, so that it constitutes 75% protein and 65% calories of each person [3]. Drought stress is considered as the most important factor to challenging and it is depends on the season that could seriously reduce wheat production [4, 5, 6, 7 and 8]. The best option for crop production, are improving production efficiency and stability under conditions of soil moisture deficiency and development of drought-resistant products [4, 8]. Grain yield components included the number of spikes per unit area, number of grain per spike and grain weight, while the effects are compensating each other; determine the grain yield in cereals [9].

In breeding of grains for drought resistance has been observed, while soil moisture is sufficient, a component of yield that have the most effective productivity, is the number of spike per unit area. Also, in drought stress conditions, number of grain per spike and sometimes the average of grain yield had equivalent share of number of spike in total performance [10]. Dofing and Knight [10] stated that effects on yield components to grain yield are positive and effects of number of spike per square meter on the other two components and effect of number of grain

per spike to grain weight were negative. Garsya del Morale et al. [11] believe that the grain yield in cereals influenced by yield components and also it is influenced by during vegetative growth and grain filling. Grain yield in cereals is one of the yield components which are relatively stable and less influenced by environmental factors. Grain yield is an environmental genetically trait which varied by different cultivars, soil fertility, soil moisture, temperature, pests and disease [12]. Sharma [10] stated that the production of high yielding varieties of wheat is only achieved through increasing biological yield together with stability of harvest index or through its increasing, simultaneously. The aim of this study was to consider the relation among traits especially grain yield and their components effecting traits in wheat genotypes under the normal and draught stress condition.

MATERIALS AND METHODS

This experiment was conducted in order to consider the relation among traits especially grain yield and their components effecting traits in wheat genotypes under the normal and draught stress condition in the research farm of Islamic Azad University of Ardabil Branch in 2012. The experiment was performed in completely randomized block design with three replications. The list of 5 studied genotypes received from the Agricultural Research Center of Ardabil is given in table 1. Land preparation operations included plowing after harvesting the previous crop, one time disc, twice vertical, fertilizer application. Based on the average of 10 plants per plot the other studied traits were: number of fertile tillers, plant height, and number of grains per spike, 1000 grain weight, number of stomata per leaf area unit, yield and ash content. To measure the number of stomata per leaf area unit trait, on the leaf surface layer of discolored varnish applied and glass glue was put on it and the leaf was put under a microscope in different measurements the number of stomata was observed. To measure the ash content, first the ready seeds were set in oven at 80 C for 24 h, and then at the temperature of 750 degrees were turned into ashes in three hours, and then the ash content was measured. Data analysis was considered using SPSS-16 and MSTAT-C software and the averages were compared using Duncan's multiple range test.

Table 1 - Genotype names used in this research

Number	Genotypes
1	Sabalan
2	Azar2
3	Fenkang
4	Gaspard
5	Mv17

RESULTS AND DISCUSSION

Variance analysis of the considered traits in wheat genotypes demonstrate that in both normal and draught stress conditions there is a meaningful difference among all traits except yield in normal condition, and the number of barrow tiller and number of stomata per leaf area unit in both condition and also the ash content in stress condition (Table 2). The highest grain yield in stress condition was due to MV17 genotype with the averages of 102. 40 kg per hectare and the lowest yield was due to Gaspard genotype with the averages of 80.15 kg per hectare. Also in drought stress conditions Azar2 genotype with the averages of 79.10 kg per hectare, and Gaspard genotype with the averages of 34.83 kg per hectare got the lowest value among all genotypes. The results of Azim zadeh and Rashed mohassel [2] showed that one thousands grain weight and number of grains per spike were of the main components of grain yield which according to direct effects and positive and meaningful correlation of them with grain yield in arid conditions we can take these in two traits as selection criteria.

Correlation of grains per spike and grain yield under normal irrigation was significant and positive, respectively (table 3 and 4) but in the drought conditions there was no significant relationship between them. The relationship between grain weight per spike and grain yield was positive and significant. Since the grain weight is one of the yield components in grains the positive and significant correlations with other traits shows that cultivars with high yield have always higher grain weight per spike. These results are consistent with the results of the work of many researchers. Including Dofing and Knight [3], and Dokoyoka and Kaya [4] stated that in drought stress conditions, number of grains per spike and occasionally mean grain weight have equal contribution as number of spike in yield. Also siman et al [11], reported the number of grains per spike and grain weight per spike to have the greatest effect on yield. Plant height of both positive and negative can have effects on yield. Plant height having a negative direct effect on grain yield, have positive indirect effects via number of days to heading, coverage percent and number of spikes per square meter. These negative effects caused the lack of significant correlation between plant height and grain yield. The results of this study corresponded with results of Foska and Peterson [5] in which the direct effect of plant height on grain yield reported to be negligible. A high height may be associated with an increase in dry matter production and harvest index reduction [9], so in case there is a negative correlation between plant height and harvest index. In some cases high height may result in lodging and grain yield decrease [13].

Table 2 - Summary of variance analysis of some studied traits in wheat genotypes under normal irrigation and drought stress conditions

S. O. V	df	Mean of Squares													
		number of fertile tillers		plant height		number of grains per spike		1000 grain weight		number of stomata per leaf area unit		Grain yield		ash content	
		drought stress	normal irrigation	drought stress	normal irrigation	drought stress	normal irrigation	drought stress	normal irrigation	drought stress	normal irrigation	drought stress	normal irrigation	drought stress	normal irrigation
Replication	2	0.06	0.667	10.368	25.313	5.305	24.2	0.462	0.993	238.2	4.067	2.478	66.43**	0.993	538.203
Genotype	4	1.04	2.725	468.5**	465.37**	275.07**	581.24**	215.08**	40.695*	198.9	307.17	0.777	22.059*	832.46*	245.374
Error	8	0.478	1.27	6.068	11.555	10.701	24.69	2.024	6.573	152.45	194.82	1.558	4.04	153.637	643.898
C. V (%)		14.22	16.89	3.46	4.32	8.8	10.89	2.92	5.08	18.53	23.14	7.43	12.57	20.46	24.37

** and ** Significantly at p < 0.05 and < 0.01, respectively.*

Table 3 - Correlation coefficients among some studied traits in non-stress conditions

	number of fertile tillers	plant height	number of grains per spike	1000 grain weight	ash content	number of stomata per leaf area unit	Grain yield
number of fertile tillers	1						
plant height	0.906*	1					
number of grains per spike	-0.405	-0.286	1				
1000 grain weight	0.912*	0.705*	-0.665	1			
ash content	-0.398	-0.306	0.969**	-0.607	1		
number of stomata per leaf area unit	0.680	0.870	-0.533	0.559	-0.558	1	
Grain yield	0.038	0.230	0.862*	-0.346	0.798*	-0.062	1

** and ** Significantly at p < 0.05 and < 0.01, respectively.*

Table 4 - Correlation coefficients among some studied traits in drought conditions

	number of fertile tillers	plant height	number of grains per spike	1000 grain weight	ash content	number of stomata per leaf area unit	Grain yield
number of fertile tillers	1						
plant height	0.457	1					
number of grains per spike	-0.502	-0.11	1				
1000 grain weight	0.162	0.732*	-0.250	1			
ash content	-0.681	-0.740*	-0.104	-0.141	1		
number of stomata per leaf area unit	-0.227	-0.907*	-0.314	-0.629	0.729*	1	
Grain yield	-0.298	0.704*	0.311	0.712*	-0.228	-0.809*	1

** Significantly at p < 0.05 respectively.*

As a general conclusion we can say that the number of grains per spike and one thousands grain weight, both of which have a significant effect on seed yield can be used as a criterion for selection of genotypes in rainfed agriculture. In general according to the calculated correlations it sounds that to achieve high yield genotypes the selection can be done based on plant height, grain weight and number of stomata per leaf area unit.

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