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ORIGINAL ARTICLE

Evaluation of Chlorophyll Content and Fluorescence Parameters as Indicators of Drought Tolerance in the International Varieties of Durum Wheat

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ABSTRACT

An experiment was conducted in the form of randomized complete blocks design as split plots with three replicates in both stressed and non-stressed conditions as the main plots by 12 durum wheat cultivars in the form of sub-plots on varieties including Fadda,Yavarus79,Altar84,Omrabi5,Zardak,Stork,Vadalmez, Omrabi6,Hurani,Korifera,Chakhmaq and Ammar, in this study leaf chlorophyll content, initial fluorescence (F0), maximum yield of photochemistry of photo system II (Fv/F0) and maximum quantum yield of photosystem II (fv/fm) were assessed in two stress and non-stress conditions, results of analysis of variance showed that grain yield and biomass, (F0), (Fv/F0), (Fv/Fm) in probability level of 1 percent and in chlorophyll content (CCI) differences were significant in probability level of 5%, the traits were analyzed for correlation and it was revealed that there was signifcant correlation between (F0) and (Fv/F0) in 1% probability level, meanwhile there was significantl relation between grain yield with biomass and also between (Fv/Fm) and (Fv/F0) in 5% probability ,considering the results of variance analysis and mean comparisons, it was concluded that the chlorophyll parameters have decreased in most traits in drought conditions and sensitive genotypes faced with most reduction, in the study it was indicated that chlorophyll components has destroyed because of drought significantly, having significance of main factor effect related to stress and normal conditions sub factor related to varieties, it can be concluded that indices chlorophyll content (CCI), F0, Fv/F0 and FV/FM are reliable ones for drought tolerance of germ plasmas.

Key words: International varieties of durum wheat.chlorophyll fluorescence and relative content parameters.drought tolerance

Introduction

Wheat is one of the important and strategic products in world wide and allocated broad level of world's lands to itself and is the main food of the people of the world. Wheat is major source of calories for more than half of the world population, it has cultivated more than any other plant in the world and number of its species is more than other plants, and it is the most compatible plant to climatic conditions and is grown in most parts of the world [3]. Durum wheat is one of the tetraploid species of genus Triticum and it was ranked as second after wheat in terms of acreage and is an important cereal in human nutrition that recently taking consideration because of its worthy production named semolina. Expanding and improving of high performance of wheat cultivars under drought conditions in arid and semi arid areas are the main issues in breeding programs in the world research centers [5]. Selection and isolation of stress tolerant genotypes were conducted in two direct (yield evaluation) and

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indirect (based on effective traits in stress tolerant methods, Durum wheat to the point of having specific properties that can occur in areas where conventional wheat in terms of weather under-cultivation difficulty of winning the same terms can durum wheat soils under different environmental stress of low efficiency such as cold, drought, heat, humidity and various antibiotics and biotic and abiotic stresses under-cultivation range.

In addition to morphological traits that plants adapted to tolerate stress conditions is involved in physiological indices of plant breeding to select superior genotypes to unfavorable environmental conditions is very important, In order to select stress tolerant genotypes, Many different methods and traits can be considered that reviewing indices and quantitative traits are important in this case [8,10,11].

Without exception in all biotic and abiotic stresses production of oxygen free radicals are considered the emergence of this active oxygen stress within the cells of animate tissue is known as oxidative stress, In general, any environmental conditions and stress that lead to the formation of reactive oxygen species, oxidative stress is the result is that the yield reduction, cell injury and death are plants, When plants are placed in water stress condition Water into plant tissue, particularly cells were low and finally the higher osmotic pressure inside the tissue, and some of the available oxygen in the cells lost their electrons and become free radicals of oxygen [1]. In normal conditions, active oxygen to get water is converted into electrons ,Many physiological and oxidase enzyme leading to active oxygen production in plant cells, which are the reactions of plant responses to environmental stress [2,4]. Respiratory responses in light of existing chemical production processes and assembly types of free oxygen in the cell and prevent an effective system to remove free oxygen are considered, In the process of respiration optical carbon dioxide is released by the enzyme *Robisko*, CO3 released again stabilized, this process increases than NADP+/NADPH to H+ in chloroplast be this way with the creation of exchange electron transport of producing active oxygen be Prevention. Respiratory responses in light of C3 plant defense mechanisms against various environmental stress such as drought and high light intensity have been reported [6].

When the light leaf meets absorbed chlorophyll a and b and in this case part of the light excess by leaf reflection is given, the action the first time in1874 by Muller by filtering colored glass was performed and indicated that Florence returned about 3-9 percent by the membrane leaves photosynthetic is associated with the absorption rate, photosynthetic light when the center will lose its energy from light reflected some find that this action by the phenomenon called *Kantsky* and *Hirsch* or work has been presented *Kantsky*, About the effects of stress associated with light and chlorophyll fluorescence characteristics, researches done and the marked numbers in the tissues more sensitive to chlorophyll degradation than the resistant varieties in environmental conditions are unfavorable, drought stress on susceptible cultivars decreased chlorophyll and descending characters initial fluorescence (F0), maximum primary yield of photochemistry of photo system II (fv/f0) and maximum quantum yield of photo system II (fv/fm) is faced with significant changes [7,9].

Materials and Methods

The experiment was conducted in research farm of Islamic Azad University of Ardabil branch in 2010-2011 years, Basic design of agricultural experiments as a randomized complete block split plot with three replications in drought conditions without stress as the main plots, with 12 known varieties of durum wheat treated with names, Fadda, Yavarus, Altar, Omrabi5, Zardak, Stork, Vadalmez, Omrabi6, Hurani, Korifera, Chakhmaq and Ammar were implemented as sub-plots, Measuring chlorophyll content and chlorophyll fluorescence was performed using the chlorophyll meter CCM-200 and OS-30p (Opi-Science), Measurements were performed randomly after12days after applying drought.About 10 flag leaves per genotype were measured and their average is considered, During the experiment traits of chlorophyll content(CCI), maximum primary yield of photochemistry of photo system II (Fv/F0) and maximum quantum yield of photosynthesis II system (Fv/Fm), were measured, after maturity, grain yield were harvested from about three square meters, All agricultural operations carried out uniformly in normal and stress condition. Drought was imposed by deleteing the final step of irrigation, During the project for analysis of variance and mean comparisons the common statistical software such as SPSS, MSTATC, SAS, EXCEL was used.

Results:

Based on the results of this experiment , main factor in chlorophyll content(CCI) and biomass were significant at 1% however, grain yield and the maximum primary yield of photochemistry of photosystem II (FV/F0) were significant at the 5% level (Table1). This table shows that normal and water stress condition disputed differently in genotype yield. Effect of Factor B was significant in the most traits, and this suggests that different cultivars have different yield. Based on the result of Mean comparisons performed by the least significant difference test (LSD) at the 5% (table2), Cultivars grouped according to grain yield in normal condition

Table 1: Split-plot design analysis of variance.

S.O.V	df	Grain yield	Biomass	CCI	F0	FV/F0	FV/FM
block	2	0.207ns	1972**	57ns	1390ns	3765ns	0.001ns
a	1	1.73*	4329**	0.024**	21591ns	131256*	0.002ns
error1	2						
b	11	0.503**	1028**	30*	587**	13914**	0.037**
ab	11	0.094ns	200ns	5.87ns	220ns	6731ns	0.041**
E2	44						
%CV	12.96	19.82	18.9		15.29	13.27	

Table 2: Mean comparisons treatments of grain and biomass yield per hectare in normal and water stress conditions.

enotype	Names	Grain			
		Stress		Normal	
1	Omrabi5	1904	ABC	5551	A
2	Altar84	3002	A	2054	CDE
3	Yavarus79	357.9	C	2734	BCD
4	Fadda	469.3	C	1288	DE
5	Korifera	1801	ABC	3801	ABC
9	Zardak	212.7	C	75.58	E
7	Stork	924.8	ABC	3729	ABC
8	Ammar	104.8	C	4508	AB
9	Hurani	2757	AB	1555	CDE
10	Chakhmaq	842.5	BC	3864	ABC
11	Omrabi6	152.3	C	1764	CDE
12	Vadalmez	1742	ABC	534.3	DE

as follow, number1 variety with 5551 kilograms of grain yield per hectare was highest in the group A, the number 6 has the lowest performance and grouped in Group E, genotype 8 has been the second yield and located in group AB and cultivar 10 had third performance and took place in ABC group (Table.2 and fig.1), According to this grouping in drought condition, variety of 2 with 3002 kilograms of grain weight per hectare had the highest yield and located in A group, the number 8 genotype has the lowest yield and located in group C, Number 9 genotype have been second yield and located in group AB respectively, numbers1 genotype third yield placed in the ABC group. Correlation analysis showed significant correlation at 1% level between initial fluorescence (F0) and maximum quantum yield of photo system II (Fv/Fm) , In addition this study was found between the trait grain yield per hectare and the amount of biomass produced by plants of wheat and between maximum quantum yield of photo system II (fv/fm) with initial fluorescence (F0), significant positive relationship in the 5% level.

Discussion:

In this study we observed that under conditions where a slight decrease of the maximum quantum yield of primary photochemistry (F_V/F_M) during drought stress was observed, it was accompanied by a decline in the performance index and by a significant change in other parameters. Significant interactions between main factor of sub factor became clear that different treatments had various yield in different conditions. main factor(drought) had significant effection chlorophyll content 1%, interactions of A×B had significant effect at 1% on (F_V/F_M) and this shows that stress applied in testing the type and genotype on (fv/fm)have been effective. Effect of B Factor has been significant 1% probability level and this will determine the genotypes of different cultivars have different yield for (fv/fm). According to the results of of mean comparisons genotypes numbers 2, 8,11,12 genotypes had the highest chlorophyll content (CCI) and genotypes 1, 2, 7 had the highest yield per hectare in normal conditions . varieties numbers 2,7,10 had the highest performance in moisture stress conditions,According to results, index and traits in genotypes tolerance to drought conditions in this study results have accordance with the results of other researchers [8,98,11]. different varieties significant at the chlorophyll content(CCI) on the main and sub plots in this study, this result showed that light respiratory reactions have been defense mechanism against drought in different wheat genotypes as the results are consistent with others [6]. About the effects of stress associated with light and chlorophyll fluorescence characteristics in performed researches, it was realized that susceptible cultivars degradation more than in terms of drought resistant cultivars in chlorophyll tissue,Significant main effects and subsidiary characters being associated with the chlorophyll traits revealed in this study that chlorophyll traits facing significant changes in different varieties that this results is consistent with results of other researchers [7,8]. According to the results was concluded that the chlorophyll parameters has declined in drought condition and sensitive genotypes faced with the most reduction, in the study it was indicated that chlorophyll components has destroyed because of drought significantly, having significance of main factor effect

Table 3: correlation analysis between traits in normal and stress condition.

	Grain	Biomass	CCI	F0	Fv/F0	FV/FM
Grain	1					
Biomass	*0.628	1				
CCI	0.065	-0.483	1			
F0	0.436	-0.132	0.318	1		
Fv/F0	0.099	-0.386	0.252	**0.789	1	
FV/FM	-0.069	-0.099	-0.321	0.271	*0.635	1

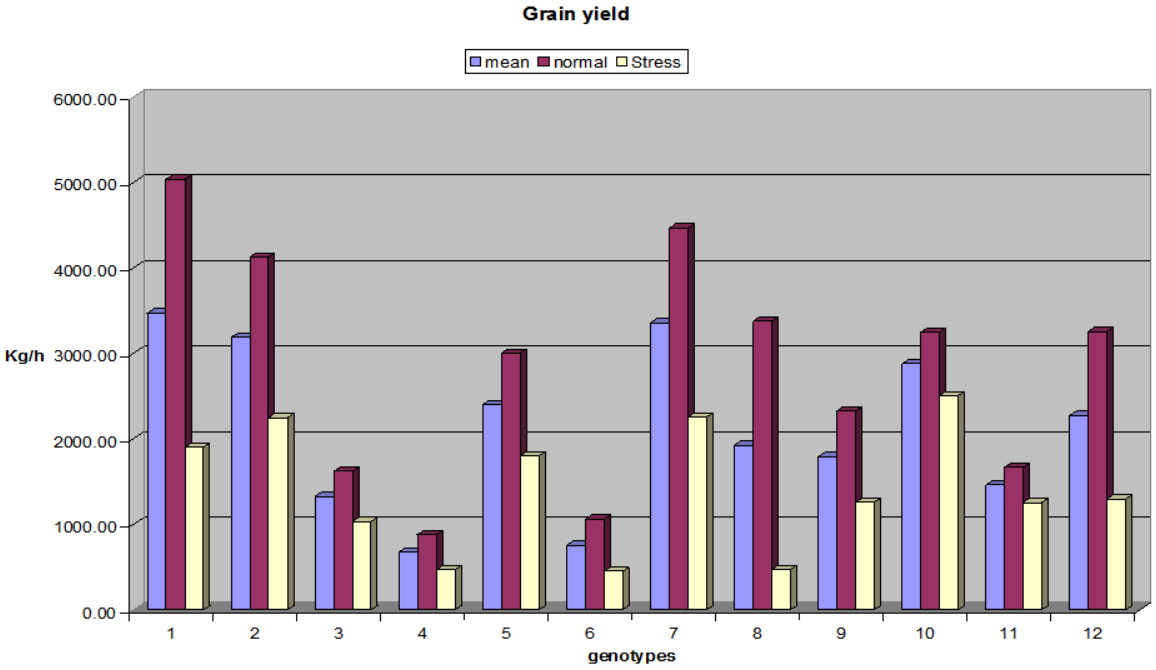

Fig. 1: Grain yield per hectare in the mean, normal, and stress conditions.

related to stress and normal conditions on varieties, it can be concluded that indices of chlorophyll content (CCI), F0, Fv/F0 and FV/FM are reliable ones for drought tolerance of germ plasmas. In summary we have shown that the measurement of fluorescence parameters, and their analysis can be that recovery depends on the severity of the drought stress in each variety.

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