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Influence of Water Deficit on Yield and Some Quantitative Traits in Wheat Genotypes

[1]Alireza Dadbakhsh, [2]Amir Yazdansepas and [3]Mostafa Ahmadizadeh
[1]Islamic Azad University-Ardabil Branch, Ardabil, Iran
[2]Seed and Plant Improvement Institute, Karaj, Islamic Republic of Iran
[3]Young Researchers Club, Jiroft Branch, Islamic Azad University, Jiroft, Iran

Abstract: Identifying the genotypes with high further transfer ability especially in grain filling period, can be a proper factor for selection in drought stress condition. In this study, in order to evaluate the amount of photosynthetic substances gathering in the grain, 19 varieties of bread wheat in the form of random complete blocks design were studied with three replications in drought stress and normal conditions. The mean grain yield genotypes in normal and drought stress conditions were respectively 5151 and 2628 kg/h. The difference among the genotypes was significant in both of conditions from different evaluating traits points of views. In normal condition, the most and the least grain yield were respectively 6580 and 4275 kg/h and in drought stress condition they were 4217 and 1650 kg/h. Correlation between the grain weight per spike was positive and significant with thousand-kernel weight in normal condition (r = 0.562). On the other hand an increase of substances weight in grain filling time causes a decrease in the amount of substances transfer to the productive part of the plant, and consequently it results in yield decrease in drought stress condition.

Key words: Correlation, drought stress, dry matter, grain yield, wheat

INTRODUCTION

Water stress is one of the main abiotic stresses and an important factor for reducing yield of cultivated plants in semi arid agricultural lands (Amin-Alim, 2011). Drought is an arising threat all over of world. Most countries of the world are facing with the problem of drought. The insufficiency of water is the principle environmental stress and causes heavy damage in many part of the world for agricultural products (Khan *et al*., 2010; Ahmadizadeh *et al*., 2011). Drought stress can reduce grain yield, due to drought stress is has been estimated the average yield loss of 17 to 70% in grain yield (Nouri-Ganbalani *et al*., 2009). Water stress in wheat changes patterns of plant growth and development, depressed water potential, cell division, organ growth, net photosynthesis, protein synthesis and alter hormonal balances of major plant tissues (Guttieri *et al*., 2001). Water stress is an important factor affecting the phasic development of wheat, and the level of stress which regulates the time of anthesis and senescence in the plant (Angust and Moncur, 1977).

Wheat is the most important agricultural good in international market and also it is one of the strategic agricultural productions which have daily and universal consumption (Mollasadeghi *et al*., 2011). Of course, wheat produces in limited ecological conditions and geographical areas, and its diffusion extent is higher than any other species due to high compatibility with environmental different weather conditions, and crop is the main food for majority of worldwide increasing population (Habibpor *et al*., 2011). 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 (Gholamin *et al*., 2010), almost 32% of wheat culture face up to various types of drought stress during the growth season in developing Countries (Shamsi, 2010). Drought tolerance consist the ability of crop against the 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 practice, planting of crop encounter 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, water deficit has always been considered as a main problem and is of great importance, so has taken into account as one of the breeding factors (Talebi, 2009).

It plays a vital role in the national economy to decrease the gap between food production and food

Corresponding Author: Mostafa Ahmadizadeh, Young Researchers Club, Jiroft Branch, Islamic Azad University, Jiroft, Iran, Tel.: +989194457655

import in developing countries (Alam *et al*., 2008). The wheat grain yield mainly depends on the formation, translocation, partitioning and accumulation of assimilates during grain filling period. Also, photosynthetic activity of source (leaves) and storage ability of the sink (grains) after anthesis are the main factors limiting wheat grain yield (Bijanzadeh and Emam, 2010). 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 (Richards *et al*., 2002). Improving drought resistance is, therefore, a major objective in plant breeding programs for reined agriculture in these regions. Knowledge of genetic behavior and type of gene action controlling target traits is a basic principle for designing an appropriate breeding procedure for the purpose of genetic improvement. Hence, the success of any selection or hybridization breeding program for developing drought-tolerant varieties depends on precise estimates of genetic variation components for traits of interest consisting of additive, dominant and non-allelic interaction effects (Farshadfar *et al*., 2011; Nouri *et al*., 2011). Nowadays many physiological, biochemical and molecular biology studies on the mechanisms of drought tolerance of agriculturally important crops have been performed (Simova-Stoilova *et al*., 2006). In plant breeding program, several characters are simultaneously considered that make it feasible to approximate the genetic divergence by using multivariate techniques. These multivariate techniques include principal component and cluster analysis which have analogous efficacy to establish the most suitable cross combinations (Amjad-Ali *et al*., 2011).

Ahmadizadeh *et al.* (2011) used multivariate analysis in 37 durum wheat genotypes under normal irrigation and drought stress conditions and Ahlawat *et al.* (2002) utilized multivariate analysis to ascertain diversity for stay green character in 36 wheat genotypes. Similarly, Golabadi *et al.* (2006) and Habibpor *et al.* (2011) worked out multivariate analysis for drought tolerance in durum wheat and bread wheat respectively. Jamal *et al.* (1996) concluded that grain yield of different wheat cultivars were significantly reduced by water stress at all critical growth stages and greatest reduction was at the anthesis stage. Plaut *et al.* (2004) also reported that the Thousand-Kernel Weight (TKW) and weight of kernels per spike were more severely decreased by water deficit than by heat in both wheat varieties and less in Batavia than in Suneca cultivars. Mohammed (1999) 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.

This study was conducted to investigate the effects of water stress on wheat to realize the effects of drought stress on dry matter shoot at anthesis, dry matter shoot at maturity, grain weight per spike, thousand kernel weight, dry matter translocation efficiency, contribution of pre-anthesis assimilates to grain and grain yield.

MATERIALS AND METHODS

This research was performed in 2008-2009 crop season in natural resources and agricultural research field of Markazi Province (Iran). To do the research, 19 wheat genotypes (Table 1) were provided from natural resources and agricultural research center in Ardabil and they were evaluated. The genotypes were planted and evaluated in two separated experiments in the form of random complete blocks design with three repetitions. Each genotype was planted in one plat with a dimension of 1.2×2 m^2. 30 cm of them were deleted due to being as the margin. The seeds of the experiment were disinfected before being planted with 2 in 1000 coefficient with fungicides carboxin thiram to avoid hidden smut. The amount of seed for planting was determined according to 450 seeds in each square meter and considered the weight of one thousand seeds for each genotype. Five stages of irrigation were considered for normal condition and three stages of irrigation for stress condition. In cases under drought stress, two times of irrigation was not done after pre-anthesis. To fight the weeds which had side leaves and also thin leaves, a mixture of Granstar and Pumasuper was used. It was respectively 20 g and 1 L in hectare in tillering stage until stem elongation. The following indices were calculated to evaluate their reaction compared to drought stress.

Remobilization of pre-anthesis assimilation was assessed according to three alternative parameters (Papakosta and Gagianas, 1991), Dry Matter Translocation (DMT), Dry Matter Translocation Efficiency (DMTE %) and contribution of pre-anthesis assimilates to grain (CPAA %):

$$DMT = DMS\ a - DMS\ m$$
$$DMTE = [DMT/DMS\ a] \times 100$$
$$CPAA = (DMT/GY) \times 100$$

In these formulas, DMSa is dry matter shoot at anthesis, DMSm is dry matter shoot at maturity and GY is grain yield. The data were statistically analyzed by MSTAT-C and SPSS software's.

RESULTS AND DISCUSSION

The results of combine analysis of the data showed that there was a significant difference between drought stress and normal conditions from some traits points of views such as dry matter shoot at maturity, grain weight per spike, thousand kernel weights, dry matter translocation efficiency and grain yield. Also there was a

Table 1: List of wheat genotypes used in study.

No.	Pedigree
1	Shahryar
2	Local Check
3	Local Check
4	Gascogene// Rsh*2/ 10120/3/ Alvd// Aldan/Las58
5	Alvd// Alaan/ las58/3/ Mv17/4/ Evwyt2/ Azd// Rsh*2/10120
6	(Alvd// Aldan/ Las)* 2/3/ Gaspard
7	Mhdv/ Soissons/4 / Bb/7C* 2/ Y50 E/ Kal*3
8	F4141- W-1- / PASTOR// PYN/ BAU
9	AU// YT542/ N10B/3/118260/4/JI/ HYS/5/YUNNATODESSKIY/6/ KS82 W409/SPN
10	ID800994. W/ VEE/3/ URES/JUN// KAUZ/ 4BUL 5052.1
11	Basswood/ Mv17
12	Basswood/ Mv17
13	Bhr* 5/Aga//Sni/3 /Trk13/4/Gaspard
14	Gds/4/ Anza/3 Pi/ Nar// Hys/5/ Vee/ Nac/6/ Gascogne
15	Gds/4/ Anza/3 Pi/ Nar// Hys/ 5/ Vee/ Nac/6/ Gascogne
16	Omid// H7/ 4P839/3/ Omid/ Tdo/ 41CWHA81-1473/5/90 Zhong/6/OwI
17	Soissons/M- 73-4//OWI852524-*3H-*O-*HOH
18	BILINMEYEN-6
19	SN64//SKE/2*ANE/3/SX/4BEZ/5/SERI/6/CHERVONA/7/ KLEIBER/2* FL80// DONSK POLUK

Table 2: Combined analysis of variance for the studied traits in bread wheat genotypes under non-stress and drought stress conditions

		Means square						
S.O.V	df	DMSa	DMSm	GW	TKW	DMTE	CPAA	GY
Condition ©)	1	0.008^{ns}	7.974^{**}	19.016^{**}	1668.274^{**}	9091.455^{**}	695.552^{ns}	181465516.667^{**}
Replication× C	4	0.025	0.013	0.012	1.769	89.444	289.534	150446.570
Genotype (G)	18	0.046^{**}	0.161^{**}	0.091^{**}	10.767^{**}	782.604^{**}	903.578^{**}	1088271.635^{**}
C × G	18	0.080^{**}	0.168^{**}	0.089^{**}	12.053^{**}	914.931^{**}	718.891^{**}	1410059.333^{**}
Error	72	0.010	0.024	0.019	4.013	197.100	242.031	187861.91

**: significant at 1% level of probability; ns: and non-significant; DMSa: Dry matter shoot at anthesis; DMSm: Dry matter shoot at maturity; GW: Grain weight per spike; TKW: Thousand kernel weight; DMTE: dry matter translocation efficiency; CPAA: contribution of pre-anthesis assimilates to grain; GY: Grain yield

significant difference among the genotypes in drought stress condition from all traits points of views which have been evaluated. In normal condition, there was a significant difference from all traits points of views except from thousand- kernel weight point of view. Most of the studied traits showed a negative reaction in drought stress condition (Table 2).

There was a high genetic diversity for the grain yield of wheat genotypes in drought stress and normal conditions. The least grain yield belonged to 19, 1, 12, 7 and 16 genotypes with 1650, 1917, 1917, 2117 and 2322 kg/h in stress condition and the most yield was for the genotype number 6 with 4217 kg/h in the same condition (stress condition). The mean grain yield in drought stress condition was 2628 kg/h. In normal condition, the least grain yield was obtained from 4, 17, 19, 1 and 9 with 4275, 4372, 4455, 4522 and 4541 kg/h and the most grain yield obtained from genotypes 10, 12, 1 and 2 with 6580, 6477, 6142 and 6048 kg/h (Table 3). Grain yield mean in normal condition has a close relation with strength and intensity of photosynthesis after flowers blossom. But photosynthesis before flowers blossom can have a deep effect on yield by means of affecting the saved segments of the plant especially in spike growth period (Moavenei and Changizi, 2007).

Araus *et al.* (2003) reported that dry substances gathering in one genotype was an indicator of water consumption efficiency in drought stress condition. Therefore the dry substance gathering more in productive parts in pollination time can be a proper factor for selecting in stress condition. In drought stress, genotypes 15, 14, 2, 10 and 3 had the least amount and genotypes 4, 6 and 8 had the most amounts from dry matter shoot at anthesis. In normal condition, genotypes 13, 8, 17, 6 and 14 had the least and genotypes 19, 16, 18, 15 and 11 had the most dry matter shoot at anthesis (Table 3). Photosynthetic substances gathering and the ability to keep these substances in peduncle depend on growth conditions before pre-anthesis (Ehdaie *et al.*, 2006). Drought stress had a negative effect on biomass weight in maturity time (Table 2). Genotypes 18, 2, 16, 17, 19 and 15 had the least and genotypes 4 and 6 had the most amounts of biomass weight at maturity time, in drought stress condition. In normal condition, genotypes number 1, 17, 9, 4 and 19 had the least biomass weight at maturity time while genotypes 2, 5, 6, 10 and 7 had the most biomass weight at that time. Drought stress occurrence in grain filling period reduces grain yield. Low weight of the grain is one of the factors which reduce the grain yield in a spike. In this study the least grain weight in a spike in drought stress condition belonged to genotype number 4 and the most amount were for genotypes number 13, 5, 18 and 2. In normal condition, genotypes 18, 12, 19, 14, and 11 had the least and genotypes 10, 2, 1, 4 and 8 had the

Table 3: Comparison means of 19 wheat genotypes under normal (C1) drought stress (C2) conditions

	DMSa		DMSm		GW		TKW	
No	C1	C2	C1	C2	C1	C2	C1	C2
1	1.54 A-C	1.68 B-D	2.01 E	2.05 CD	1.970 A	0.71 E-I	33.4	27.50 A-C
2	1.53 A-C	1.33 F	3.07 A	1.70 C-F	1.940 AB	0.88 A-C	35.9	24.90 B-E
3	1.56 A-C	1.40 D-F	2.33C-E	1.93 AB	1.670 A-D	0.82 C-E	36.03	24.87 B-E
4	1.48 BC	1.95 A	2.29 C-E	2.32 C	1.720 A-D	0.51 J	35.03	26.00 A-D
5	1.47 BC	1.42 D-F	2.89 AB	2.10 A	1.580 A-D	0.98 A	35.4	23.80 DE
6	1.46 BC	1.86 AB	2.74 A-C	2.45 BC	1.630 A-D	0.79 C-F	33.17	28.60 A
7	1.48 BC	1.63 B-E	2.66 A-D	2.13 C	1.540 A-D	0.68 F-I	33.4	24.40 B-E
8	1.46 BC	1.77 A-C	2.46 B-E	2.10 C-E	1.700 A-D	0.75 D-G	33.57	24.20 C-E
9	1.49 BC	1.50 C-F	2.21 DE	2.00 C-E	1.480 B-D	0.65 G-I	32.23	21.80 EF
10	1.49 BC	1.39 EF	2.69 A-D	1.85 D-F	1.830 A-C	0.74 E-H	32.53	25.40 A-D
11	1.57 A-C	1.59 B-F	2.59 A-D	1.96 C-F	1.410 CD	0.61 I	31.73	20.30 F
12	1.47 BC	1.68 B-D	2.56 B-D	2.05 CD	1.280 D	0.71 E-I	31.33	27.50 A-C
13	1.40 C	1.46 D-F	2.42 B-E	2.10 C	1.530 A-D	0.93 AB	32.73	23.60 DE
14	1.47 BC	1.33 F	2.45 B-E	1.92 C-F	1.310 D	0.77 D-F	31.9	27.63 AB
15	1.57 A-C	1.31 F	2.57 A-D	1.82 EF	1.580 A-D	0.77 D-F	30.5	26.00 A-D
16	1.66 AB	1.43 D-F	2.62 A-D	1.75 F	1.470 B-D	0.85 B-D	31.8	28.40 A
17	1.46 BC	1.64 B-E	2.19 DE	1.59 EF	1.700 A-D	0.69 F-I	31.1	26.70 B-E
18	1.60 A-C	1.49 D-F	2.41 B-E	1.64 H	1.230 D	0.88 A-C	31.7	28.07 A-D
19	1.73 A	1.41 D-F	2.30 C-E	1.49 E-H	1.300 D	0.66 HI	31.37	26.67 DE

	DMTE		CPAA		GY	
No	C1	C2	C1	C2	C1	C2
1	97.40 A	20.05 CD	76.09 A	47.32 A-D	4522.00D-E	1917.00 CD
2	26.19 B-D	38.11 AB	20.67 B-C	57.39 AD	6048.00A-C	2383.00 B-D
3	58.30 A-D	20.32 CD	52.98 A-C	35.28 BD	5197.00 C-F	2967.00 BC
4	60.74 A-C	6.92 D	51.09 A-C	26.73 BD	4275.00 F	3133.00 B
5	11.43 D	20.85 CD	10.62 C	30.10 BD	5149.33C-F	2867.00 BC
6	23.18 B-D	10.63 D	21.59 B-C	25.00 CD	4633.00D-F	4217.00 A
7	24.15 B-D	10.77 D	23.39 B-C	25.74 B-D	5181.33 C-F	2117.00 B-D
8	49.78 B-D	23.68 BD	36.91 A-C	58.01 A-D	4779.67 D-F	2794.33 B-D
9	51.20 B-D	9.70 D	48.40 A-C	22.31 D	4541.33 D-F	2817.00 B-C
10	42.55 B-D	20.05 CD	34.54 B-C	37.87 B-D	6579.67 A	3017.00 B-C
11	24.67 B-D	15.07 CD	28.40 B-C	39.27 B-D	5429.33C-E	2533.00 B-D
12	13.02 CD	20.05 CD	15.09 B-C	47.32 A-D	6476.67AB	1917.00 CD
13	36.94 B-D	19.96 CD	33.70 B-C	31.18 B-D	6141.67A-C	2678.00 B-D
14	22.29 B-D	13.15 CD	24.76 B-C	23.61 CD	4632.00D-F	2877.67 BC
15	35.45 B-D	19.72 CD	34.02 B-C	33.44 B-D	5501.00B-D	2350.00 B-D
16	31.00 B-D	37.39 AB	32.16 B-C	61.64 A-C	4731.67D-F	2322.33 B-D
17	66.35 AB	44.15 BC	56.83 AB	92.37 AB	4372.00EF	2722.33 B-D
18	26.00 B-D	48.98 A	33.70 BC	82.82 A	5222.00C-F	3200.33 B-D
19	41.27 B-D	41.71 CD	55.32 AB	87.62 B-D	4455.00D-F	2050.00 D

Differences between averages of each column which have common characters are not significant at probability level of 5%; DMSa: Dry matter shoot at anthesis; DMSm: Dry matter shoot at maturity; GW: Grain weight per spike; TKW: Thousand kernel weight; DMTE: dry matter translocation efficiency; CPAA: contribution of pre-anthesis assimilates to grain; GY: Grain yield

most amounts of this trait. The most weight of thousand-kernel was for genotypes number 6, 16, 14, 1 and 12 and the least weight belonged to genotypes number 1 and 9 in drought stress condition (Table 3). In the study by Ahmadi and Baker (2001) it was observed that the amount of humidity and sucrose in the grain which are two important and effective factors on cell division, were not influenced by the exerted humidity stress in grain filling time. Therefore the observed reduction in the grain weight in that condition was attributed to rain filling process, not to cell division. On the other hand, humidity stress in the first stages of grain filling might affect grain filling and consequently the grain yield by decreasing the number of endosperm cells (Nicolase *et al*., 1985). The most amount of further transfer belonged to genotypes number 18, 2 and 16 and the least amount of it was for genotypes 4, 9, 6 and 7 in drought stress condition (Table 3). The share of substances movement in grain yield was affected by two factors; transferred substances amount and yield changes of genotypes grain. In normal condition the current photosynthesis is not able to fill the grains itself, and it was somehow dependent on the saved substances transfer. Identifying the genotypes which have high further transfer ability in drought stress condition especially in grain filling stage provides the possibility to increase grain yield without any increase in the amount of consumed water (Ehdaie *et al*., 2006).

The results showed that drought stress occurrence had a significant effect on the amount of the saved substances corporation before the appearance of anther in drought stress condition had more relative importance compared to normal condition. In normal condition, the function of current photosynthesis is more in grain filling process since this process is less expensive than further

Table 4: Correlation coefficients between mean of studied traits in non-stress condition

	DMSa	DMSm	GW	TKW	DMTE	CPAA
DMSm	- 0.093					
GW	- 0.283	0.069				
TKW	- 0.243	0.291	0.562*			
DMTE	0.03	- 0.766**	0.572*	0.109		
CPAA	0.27	- 0.856**	0.330	- 0.047	0.944**	
GY	- 0.213	0.526*	0.027	0.005	- 0.433	- 0.509*

**: significant at 1% level of probability; *: significant at 5% level of probability; DMSa: Dry matter shoot at anthesis; DMSm: Dry matter shoot at maturity; GW: Grain weight per spike; TKW: Thousand kernel weight; DMTE: Dry matter translocation efficiency; CPAA: Contribution of pre-anthesis assimilates to grain; GY: Grain yield

Table 5: Correlation coefficients between mean of studied traits in drought stress condition

	DMSa	DMSm	GW	TKW	DMTE	CPAA
DMSm	0.645**					
GW	- 0.527*	- 0.131				
TKW	0.105	- 0.134	0.139			
DMTE	- 0.342	- 0.832**	0.350	0.352		
CPAA	- 0.081	- 0.766**	0.045	0.341	0.930**	
GY	0.279	0.411	0.144	0.099	- 0.206	- 0.255

**: significant at 1% level of probability; *: significant at 5% level of probability; DMSa: Dry matter shoot at anthesis; DMSm: Dry matter shoot at maturity; GW: Grain weight per spike; TKW: Thousand kernel weight; DMTE: Dry matter translocation efficiency; CPAA: Contribution of pre-anthesis assimilates to grain; GY: Grain yield

transfer (Blum, 1998). But in stress condition, the plant breathes more because the stomata are closed (Kuhad and Sheoran, 1982). Therefore, the current photosynthesis reduces and the saved preserved substances before pre-anthesis stage will help the current photosynthesis and play a role in grain formation.

In this research, in normal condition, genotypes number 9, 14, 6, 7 and 4 had the least and genotypes number 18, 17, 16, 8 and 2 had the most share of further transfer of accumulative substances in grain yield. The overall results of this research correspond to the findings of Cox *et al.* (1990), Entz and Flower (1990) and Moayedi *et al.* (2009) about genetic diversity existence from efficiency and fourth movement potential of substances to the grain in wheat genotypes. Pheloung and Siddique (1991) found the species with high yield that had less resource gathering. Before pre-anthesis and yield reduction in these varieties were more in drought stress condition. The existent variety among the genotypes from the related parameters to further movement of dried substance point of view in stress and normal condition can depend on the genetic potential of the plant in best use of stored substances and variable biological yield and grain yield. Also high capacity of the grain for accumulation the dry substance has an important role in further distribution of the substances (Mainard and Jeuffroy, 2001).

Correlation coefficients among the studied traits have been stated in Table 4 and 5. In normal condition, the grain weight per spike had a positive and significant correlation with thousand kernel weight and dry matter translocation efficiency. On the other words the more the weight of the grain in a spike, the more the weight of the thousand-kernel will be. It corresponds to the results of Peghambari *et al.* (2005). Also a positive and significant correlation was observed in normal condition between dry matter shoot at maturity and grain yield. Dry matter shoot at maturity had a negative and significant correlation with dry matter translocation efficiency and contribution of pre-anthesis assimilates to grain in normal condition. In drought stress condition, dry matter shoot at anthesis had a negative and significant correlation with dry matter shoot at maturity. Grain weight per spike had a negative correlation with dry matter shoot at anthesis. Dry matter shoot at maturity had negative and significant correlation with dry matter translocation efficiency and contribution of pre-anthesis assimilates to grain. That was, the increase of biomass weight during grain filling causes a decrease in the share of these substances transfer amount and consequently it causes a decrease in the share of these substances in grain filling in drought stress condition. However in some cases efficiency trait of further distribution of the substances in stress condition has been evaluated as one of the important factors of the grain yield stability of wheat genotypes (Entz and Flower, 1990; Grant, 1992). But in the results of this research any significant correlation was not observed between further transfer and the share of further transfer and grain yield in stress condition. The mentioned results correspond to the results of Clarke *et al.* (1984). Moavenei and Changizi (2007) found out in their research that in some varieties with due attention to the most amount of photosynthetic substances transfer they had, their yield was less compared to the other varieties, photosynthetic substances transfer had been affected extensively by water stress. This shows the lack of the substances transfer which have been made to the grain.

CONCLUSION

However it is possible that great part of stored substance in the wheat grain obtain by running photosynthesis of pollination until physiological perfection of plant, but due to buffering rule of renewed restored substances of growing organs to grain, in environmental stresses it prevents the deduction of grain yield. In the breeding programs, determination of effective traits in this process and the genotypes which contain these traits for obtaining genotypes with grain yield and high potential for renewed transition is of great importance.

REFERENCES

Ahlawat, S.K., M.M.C. Singh, R. Kumar, S. Kumari and B.K. Sharma, 2002. Time trends in the prevalence of hypertension and associated risk factors in Chandigarh. J Ind. Med. Assoc., 10: 547-555.

Ahmadi, A. and D.A. Baker, 2001. The effect of water stress on grain filling processes in wheat. J. Agric. Sci., 138: 257-269.

Ahmadizadeh, M., H. Shahbazi, M. Valizadeh and M. Zaefizadeh, 2011. Genetic diversity of durum wheat landraces using multivariate analysis under normal irrigation and drought stress conditions. Afr. J. Agric. Res., 6(10): 2294-2302.

Alam, M.S., A.H.M.M. Rahman, M.N. Nesa, S.K. Khan and N.A. Siddquie, 2008. Effect of source and/or sink restriction on the grain yield in wheat. Eur. J. Appl. Sci. Res., 4: 258-261.

Amin-Alim, M., 2011. The effects of water and heat stress on wheat. Agric. Trop. Et Subtropica, 44(1): 44-47.

Amjad-Ali, M., K. Jabran, S.I. Awan, A.A. Ehsanullah, M. Zulkiffal, T. Acet, J. Farooq and A. Rehman, 2011. Morpho-physiological diversity and its implications for improving drought tolerance in grain sorghum at different growth stages. AJCS, 5(3): 308-317.

Angust, J.F. and M.W. Moncur, 1977. Water stress and phonology in wheat. Aust. J. Agri. Res., 28: 177-181.

Araus, J.L., J. Bort, P. Steduto, D. Villegas and C. Royo, 2003. Breeding cereal for Mediterranean conditions: Ecophysiological clues for biotechnology application. Annal. Appl. Biol., 142: 129-141.

Bijanzadeh, E. and Y. Emam, 2010. Effect of defoliation and drought stress on yield components and chlorophyll content of wheat. Pak. J. Biol. Sci., 13(14): 699-705.

Blum, A., 1998. Improving wheat grain filling under stress by stem reserve mobilization. Euphytica, 100: 77-83.

Clarke, J.M., T.F. Townley-Smith, T.N. Mc-C-Aig and G. Green, 1984. Growth analysis of spring wheat cultivars of varying drought resistance. Crop Sci., 24: 573-970.

Cox, M.C., C.O. Qualset and D.W. Rains, 1990. Genetic variation for nitrogen assimilation and translocation wheat. III: Nitrogen translocation in relation to grain yield and protein. Crop Sci., 26: 737-740.

Ehdaie, B., G.A. Alloush, M.A. Madore and J.G. Waines, 2006. Genotypes variation for stem reserves and mobilization in wheat. I. Postanthesis changes in internod dry matter. Crop Sci., 46: 735-746.

Entz, M.H. and D.B. Flower, 1990. Differential agronomic responses of winter wheat cultivars to post-anthesis environmental stress. Crop Sci., 30: 1119-1123.

Farshadfar, E., V. Rasoli, J.A. Teixeira-da-Silva and M. Farshadfar, 2011. Inheritance of drought tolerance indicators in bread wheat (*Triticum aestivum* L.) using a diallel technique. AJCS, 5(7): 870-878.

Gholamin, R., M. Zaeifizadeh, M. Khayatnezhad, S. Jamaati-e-Somarin and R. Zabihi-e-Mahmoodabad, 2010. Study of drought tolerance in durum wheat genotypes. American-Eurasian J. Agric. Environ. Sci., 9(5): 465-469.

Golabadi, M., A. Arzani and S.A.M.M. Maibody, 2006. Assessment of drought tolerance in segregating populations in durum wheat. Afr. J. Agric. Res., 1: 162-171.

Grant, R.F., 1992. Interactions between carbon dioxide and water deficits affecting canopy simulation and testing. Crop Sci., 32: 1322-1328.

Guttieri, M.J., J.C. Stark, K.O. Brien and E. Souza, 2001. Relative sensitivity of spring wheat grain yield and quality parameters to moisture deficit. Crop. Sci., 41: 327-335.

Habibpor, M., M. Valizadeh, H. Shahbazi and M. Ahmadizadeh, 2011. Genetic diversity and correlation among agronomic and morphological traits in wheat genotypes (*Triticum Aestivum* L.) under influence of drought. Adv. Environ. Biol., 5(7): 1941-1946.

Jamal, M., M.S. Nazir, S.H. Shah and A. Nazir, 1996. Varietal response of wheat to water stress at different growth stages and effect on grain yield, straw yield, harvest index and protein contents in grains. Rachis, 15(1-2): 38-45.

Khan, A.S., S. Ul-Allah and S. Sadique, 2010. Genetic variability and correlation among seedling traits of Wheat (*Triticum aestivum*) under water stress. Inter. J. Agric. Biol., 2: 247-250.

Kuhad, M.S. and L.S. Sheoran, 1982. Effect of iso-osmotic levels of salt and water stress on photosynthesis, respiration and nitrogen fixation in guar. Proc. Biol. N2 Fixation. D.A.E., pp: 323-335.

Mainard, S.D. and M.H. Jeuffroy, 2001. Partitioning of dry matter and N to the spike throughout the spike growth period in wheat crops subjected to N deficiency. Field Crops Res., 70: 153-165.

Moavenei, P. and M. Changizi, 2007. Plant Physiology under Drought and Salinity. Vol. 1. Islamic Azada University, Arak Branch Publications, Arak, Iran.

Moayedi, A.A., A.N. Boyce and S.S. Barakbah, 2009. Influence of water deficit during different growth and developmental stages on the contribution of stored pre-anthesis assimilates to grain in selected durum and bread wheat genotypes. Aust. J. Basic Appl. Sci., 3: 4408-4415.

Mohammed, A.I.S., 1999. Promising durum wheat genotypes under normal and stress growing conditions in Northern Sudan. Rachis, 16(2): 64-66.

Mollasadeghi, V., R. Shahryari, A.A. Imani and M. Khayatnezhad, 2011. Factor analysis of wheat quantitative traits on yield under terminal drought. Am. Eur. J. Agric. Environ. Sci., 10(2): 157-159.

Nicolase, M.E., R.M. Gleadow and M.J. Dalling, 1985. Effect of post-anthesis drought on cell division and starch accumulation in developing wheat grains. Ann. Bot., 66: 665-672.

Nouri-Ganbalani, A., G. Nouri-Ganbalani and D. Hassanpanah, 2009. Effects of drought stress condition on the yield and yield components of advanced wheat genotypes in Ardabil, Iran. J. Food Agric. Environ., 7(3-4): 228-234.

Nouri, A., A. Etminan, J.A. Teixeira-da-Silva and R. Mohammadi, 2011. Assessment of yield, yield related traits and drought tolerance of durum wheat genotypes (*Triticum turjidum* var. *durum* Desf.). Aus. J. Crop Sci., 5(1): 8-16.

Papakosta, D.K. and A.A Gagianas, 1991. Nitrogen and dry matter accumulation, remobilization and losses for Mediterranean wheat during grain filling. Agro. J., 83: 864-870.

Peghambari, A., B. Yazdi-Samadi, S. abdmishani, A. Sarafi, A. Taleei and M. Ghanadha, 2005. Evaluation of drought tolerance and yield-related traits in barley doubled haploid lines. Iranian J. Agric. Sci., 36(4): 955-967.

Pheloung, P.C. and K.H.M. Siddique, 1991. Contribution of stem dry matter to grain yield in wheat cultivars. Aust. J. Plant Physiol., 18: 53-64.

Plaut, Z., B.J. Butow, C.S. Blumenthal and C.W. Wrigley, 2004. Transport of dry matter into developing wheat kernels and its contribution to grain yield under post- anthesis water deficit and evaluated temperature. Field Crop Res., 86: 185-198.

Richards, R.A., G.J. Rebetzke, A.G. Condon and A.F. Herwaarden, 2002. Breeding Opportunities for increasing the efficiency of water use and crop yield in temperate cereals. Crop Sci., 42: 111-121.

Shamsi, K., 2010. The effects of drought stress on yield, relative water content, proline, soluble carbohydrates and chlorophyll of bread wheat cultivars. J. Anim. Plant Sci., 8(3): 1051-1060.

Simova-Stoilova, L., V. Vassileva, T. Petrova, N. Tsenov, K. Demirevska and U. Feller, 2006. Proteolytic activity in wheat leaves during drought stress and recovery. Gen. Appl. Plant Physiol. Special Issue, pp: 91-100.

Talebi, R., 2009. Effectiveselection criteria for assessing drought stress tolerance in Durum wheat (*Triticum durum* Desf.). Gen. Appl. Plant Physiol., 35(1-2): 64-74.