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Research article

MOLECULAR CHARACTERIZATION AS A DEFENSIVE SYSTEM OF WHEAT GENOTYPES UNDER DROUGHT STRESS

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ABSTRACT: The experiment was carried out in Western Azerbaijan agricultural research center at Miandoab station in growing season 2009-2011. Main plots in this experiment included Different levels of irrigation after heading stage (70, 100 130 and 160 mm evaporation from class A pan) and the sub-plots consisted of 10 genotypes of bread wheat were planted in six rows. Drought is an important environmental factor, which induces significant alterations in plant physiology and biochemistry. Carotenoids are a large class of isoprene molecules, which were synthesized by all photosynthetic and many non-photosynthetic organisms. Results of analysis of variance show that significant differences between the fore late drought stress levels on carotene, Flavonoid, Fenol Tom, sucrose, fructose, glucose, proline and grain yield, Also inter action effect of drought stress level and genotype had the significant effect on same treat and it was show that the drought had a significant effect on biochemical regulation against drought condition. Otherwise correlation coefficient table for measured treat showed the high positive and negative correlation between measured treat in drought stress condition and there could be a mechanism for scape the drought period in experimental variety and line. Grain yield were affected by photosynthesis rate of crop and it was dependent light harvesting by organic complex like carotenoids and xanthophylls. Synthesis of lipids and pigments such as chlorophyll, xanthocynin and carotenoid is interrupted by water stress, and dues the high grain yield variety and genotype should have the molecular defensive mechanism as shown in this phase.
Key word: wheat variety and genotype, photosynthetic pigment, soluble sugar and yield.

INTRODUCTION

Drought stress affects 40 to 60 percent of the world's agriculture lands [33]. Much of the land under wheat cultivation has been in arid and semiarid regions. Drought in Iran was considered as the most important factor limiting crop growth and production. In these areas, Understanding the effect of drought stress and temperature regimes on molecular characteristic and yield were the effective step in the development of cultivars with high yield and stable situation [15]. Drought is an important environmental factor which induces significant alterations in plant physiology and biochemistry. Some plants exhibit a number of physiological adaptations that allow them to tolerate water stress conditions. Plants adaptations to dry environments can be expressed at four levels: phenological or developmental, morphological, physiological, and metabolic and the last one known and understood as metabolic or biochemical adaptations involved [16]. Photosynthetic pigments are important to plants mainly for harvesting light and production of reducing powers [12]. Carotenoids are a large class of isoprene molecules, which are de novo synthesized by all photosynthetic and many non-photosynthetic organisms [4]. Carotenoids have a very important role in photosynthesis. Biosynthesis of carotenoids in plants is a genetic characteristic, but environmental conditions also have an essential role. They are involved in light harvesting, energy transduction and protection against damage by photo-oxidation [12]. However, carotenoids have additional roles and partially help the plants to withstand adversaries of drought. Total carotenoid content were found that decline under water deficit conditions. The rate of decline in a drought-sensitive cultivar was much faster than in a more drought resistant cultivar. Oxidative damage generated by drought stress in the plant tissue is alleviated by a concerted action of both enzymatic and non-enzymatic antioxidant systems. Carotenes form a key part of the plant antioxidant defense system, but they are very susceptible to oxidative destruction. Water stress, among other changes, has the ability to reduce the tissue concentrations of chlorophylls and carotenoids [18], other wise Plant have developed and complex biochemical defense system that including carotenoids and flavonoid. Flavonoid compounds, as secondary metabolites are considered to play a major role in protecting plants from UV-B damage [22].

These flavonoid generally absorb the light in the region of 280~320 nm and thus are capable of acting as a UV filter, thereby protecting the photosynthetic tissues from damage [32]. Flavonoids stabilize and protect the lipid phase of the thylakoid membrane, and are quenchers of the excited triplet state of chlorophyll and singlet oxygen [1]. Apart from the carotenoids, flavonoid also has antioxidant properties which act as an internal filter against UV-B radiation. Plants scavenge reactive oxygen species by detoxification mechanism produced by enzymatic antioxidant such as catalase, peroxidase, superoxide dismutase and phenylalanine ammonia–lyase etc. [26]. Both Physiological and biochemical changes including carbohydrates, proteins and lipids Observed in many plant species under various water stress levels, which may help in better understanding survival mechanisms in drought.

The available reports stated that the content of soluble sugars and other carbohydrates in the leaves of various water stressed plants are altered and may act as a metabolic signal in the response to drought [2, 3, 8] however, accumulation or decrease of sugars depending on stress intensity and role of sugar signaling in these processes is not totally clear yet [8]. Drought stress is a decrease of soil water potential so plants reduce their osmotic potential for water absorption by congestion of soluble carbohydrates and proline and in other words osmotic regulation is performed [24]. Carbohydrates, which among other substrates are essential for cell growth, are produced via photosynthesis and the latter is significantly reduced under stress conditions [36]. The aim of this study was to investigate the effect of water stress on the activities of some soluble sugar (Sucrose, Fructose, Glucose and Proline), Photosynthetic pigments (Carotene, Flavonoied and Phenol tom) of 20 barley promising lines/cultivars.

MATERIALS AND METHODS

Plant materials were performed in the form of strip plot on the basis randomized complete block designs, with fore replications in the close location. The experiment was carried out in Miyandoab Agricultural and Natural Resources Research Station, in growing season 2010-2011. The experimental field station was located in latitude 36° 58', longitude 46° 6' and altitude 1371m, by a typical silty loam texture. Before planting, the soil tillage was practiced based on the research station/s routine. Fertilizers were applied before sowing (100kg ha^{-1} P_2O_3 and 50kg ha^{-1} N) in October, and at stem elongation (50kg ha^{-1} N) in March.

Main plots in this experiment included Different levels of irrigation after heading stage (70, 100 130 and 160 mm evaporation from class A pan) and the sub-plots consisted of 10 genotypes of bread wheat (Zarrin, Shahriar, Alvand, Sardari, C-80-4, C-81-10, C-81-4, C-83-3, C-83-8 (Zare) and C-83-9 (Pishgam)). Seeding rates for all wheat genotypes was 450 seed/m^2 and each line was planted in 6 rows with 20 cm apart and 5 m long. Irrigation treatments were applied after heading stage. To prevent the penetration of water main plots spacing together between the two meters. The field was watered with siphons and the amount of the irrigation is accounted. To quantify soluble sugar and Photosynthetic pigments, fifteen young leaf samples were taken randomly from each plot and were placed in liquid nitrogen and then stored at -80°C pending biochemical analysis. Leaf sampling from all plot were done after 70% evaporation of each irrigation treatment. Carotenoid content was estimated using the formula of Kirk and Allen [19] and expressed in milligrams per gram dry weight. The total flavonoid content of the sample was determined using ammonium chloride colorimetric method as described by Chang [7], with slight modifications.

For Measurements of compatible solutes seven flag leaves per plot were dried and ground. 0.02 g dry weight of leaf tissue was extracted in 2 ml of 70% (v/v) ethanol and centrifuged at 2000g for 10 min. The pellet was washed with 2ml of 70% ethanol and then with 0.8ml distilled water. The pooled supernatant was mixed with an equal volume of chloroform and the aqueous phase was recovered and brought to 4ml with distilled water. Soluble carbohydrates and proline were determined by methods of anthrone and ninhydrin [6] respectively. After maturity, yield and yield components were measured and analysis of data was done using MSTATC Statistical Program.

RESULTS AND DISCUSSION

Results of analysis of variance show that significant differences between the fore drought stress levels on Flavonoid, Fenol Tom, sucrose, fructose, glucose content level and grain yield (Table 1) ($p<0.01$). Also inter action effect of drought stress level and genotype had the significant effect on carotenoied, fenol tom, sucrose, fructose, glucose and grain yield level and its show that the drought had a significant effect on genotype biochemical regulation level that affected by drought stress condition (Table 1) ($p<0.01$). At the other hand result were showed the different in proline concentration level (Table 1) ($p<0.05$) and it could be due to the difference of genotype to scape the drought. Otherwise correlation coefficient table for measured treat showed the high positive and negative correlation between measured treat (Table 2), and it could be due to the regulation of metabolic treat in a shape of down regulated or up regulated in drought stress condition and there could be a mechanism for scape the drought period in experimental variety and line.

Table-1: Variance Analysis of wheat genotypes traits under drought stress

SOV	df	Ms							
		Carotene	Flavaonoid	Fenol Tom	Sucrose	Fructose	Glucose	Proline	Grain yield
Replication	3	7.719	0.906	0.9022	116.204	219.001	162.145	67.022	0.908
Drought level	3	10.166	16.408**	94.9257**	564.972**	14738.833**	25272.104**	72583.783**	29.031**
Genotype	9	17.598**	109.943**	3302.941**	3423.096**	6518.655**	9593.091**	13924.756**	7.464**
Drought level * Genotype	27	19.451**	3.833	100.933**	52.216**	156.939**	246.886**	712.681*	1.062**
Error	117	6.705	2.790	50.847	18.469	31.768	109.871	419.781	0.288
CV%		17.38	16.39	8.08	9.68	8.12	11.22	15.58	10.99

*, **: Indicate significant differences at levels 0.05 and 0.01 level respectively.

Carotenoied

Shahriar variety at 70 mm evaporation from E.T pan had the highest carotenoied level (20.08 milligram/ gr leaf DW)between the variety and genotype, zarrin under 100 evaporation from E.T pan conditions has the lowest carotenoied level (10.02 milligram/ gr leaf DW). In contrary C-83-9 at 170 mm evaporation from E.T pan conditions were showed the high concentration of carotenoied (19.61milligram/ gr leaf Dw) and its could be due to the up regulated of carotenoied synthesis in this variety and carotenoids have additional roles and partially help the plants to withstand adversaries of drought. Total carotenoid content were found that decline under water deficit conditions (Figure 1). The rate of decline in a drought-sensitive cultivar was much faster than in a more drought resistant cultivar. High carotenoied level under stress could express tolerant genotype, because it may be a mechanism for escape from the stress (Table 3). Water stress, among other changes, has the ability to reduce the tissue concentrations of chlorophylls and carotenoids (Kiani et al., 2008), primarily with the production of ROS in the thylakoids [30]. However, reports dealing with the strategies to improve the pigments contents under water stress. The available reports show that exogenous application of methyl jasmonate improved the drought tolerance with increased activities of SOD, CAT and APX, ABA and total improved carotenoid contents in maize [23], while methyl jasmonate brought about a threefold increase in the β-carotene synthesis as well as degradation of the chlorophyll contents in the epidermal peels [27]. Likewise, an important role of tocopherols, lipid-soluble antioxidant in chloroplasts, has been envisioned in improved pigments contents under stress conditions in the photosynthetic organisms including tobacco [34] and Arabidopsis thaliana [11].

Flavonoid and fenol tom

C-83-9 (13.87 milligram/ gr leaf DW) genotype under 100 mm evaporation from E.T pan conditions has the highest flavonoid level. In contrary C-83-3 at 100 mm evaporation from E.T pan conditions and C- 81-10 at 70 mm evaporation from E.T pan conditions with 5.361 and 5.517 milligram/gr leaf DW was the lowest values of flavonoid concentration respectively. High flavonoid level under stress could express tolerant genotype, because it may be have mechanism escape from the stress (Table 3). Treat mean showed that genotype C-83-9 had the highest level of flavonoid concentration between other genotype and variety in all of drought stress level. Flavonoid stabilizes and protects the lipid phase of the thylakoid membrane, and is quenchers of the excited triplet state of chlorophyll and singlet oxygen (Agawal and Rathore, 2007). Mean analyze showed that C-83-9 genotype with 122.5 milligram/ gr leaf DW under170 mm evaporation from E.T pan drought stress level after heading have the highest fenol tom level. In contrary C-81-10 at 70 mm evaporation from E.T pan conditions with 56.43 milligram/gr leaf DW were the lowest values (Figure 2). Treat mean showed that the concentration of fenol tom is up regulated approximately in all of genotype and variety (Figure 3). Oxidative damage generated by drought stress in the plant tissue is alleviated by a concerted action of both enzymatic and non-enzymatic antioxidant systems (Table 3).with no attention to genotype we could see that the highest level of flavonoid could be determined in high drought stress (170 mm Evapotranspiration from E.T pan) level and it were due to the regulation of genotype fore scape the drought for sustainable there interior condition and show that resistance genotype as a defensive system regulated there flavonoid and fenol tom level. Result of Correlation coefficient (Table 2) showed the high positive correlation ($p<0.01$) between flavonoid and fenol tom level in wheat variety and genotype ($r^2 = 0.868$). Flavonoid were the important part of plant defense system and in environmental stress such as water stress chemical composition of plant are increase and it could be the both of primary and secondary metabolites.

Fructose and Glucose

Base on analyze of variance result for chemical treat of bread wheat genotype and variety C-83-9 genotype with 135.00 milligram/gr leaf DW under 170 mm evaporation from E.T pan conditions has the highest fructose level between the other genotype and variety.

In contrary alvand with the 33.67 milligram /gr leaf DW under 100 mm evaporation from E.T pan (second level of drought condition) had the lowest one (Table 3). It could be due to the regulation reflex of plant for scape the drought. The available reports stated that the content of soluble sugars and other carbohydrates in the leaves of various water stressed plants are altered and may act as a metabolic signal in the response to drought [2, 3, 8]. This is believed to be due to osmotic adjustment, the process in which solutes accumulate in growing cells as their water potential falls [25]. Accumulation of solutes in response to osmotic potential decreasing from the net and thus maintaining turgor in tissues, osmotic adjustment may allow growth to continue at low water potential. At the other hand we could saw the same situation for glucose that highest level of drought (170 mm evaporation from E.T pan conditions) showed the highest level of glucose concentration with 166.00 milligram /gr leaf DW in C-83-9 genotype (Table 3). This result was the same as the fructose data and base on correlation coefficient result (Table 2) fructose concentration had the high and positive relation with glucose ($r^2 = 0.750$). Adaptation to all these stresses is associated with metabolic adjustments that lead to the accumulation of organic solutes such as sugars, polyols, betaines and proline [14, 35].

Proline

Many various inhibitor factor can be accrued in plant life cycle in the field such as heat, drought and cold, dues plant should have been a way for escape this condition in there hole life and it could be fundamental change in biochemical and physiological process, the assumption behind this approach has been that over production of these osmolytes may help plants to tolerate stress by improving their ability to adjust osmotically [31]. In these study Base on analyze of variance result for chemical treat of bread wheat genotype and variety C-83-9 genotype with 274.7 milligram/gr leaf wet weight under 170 mm evaporation from E.T pan conditions has the highest proline level between the other genotype and variety (table 3). In contrary C-81-4 with the 69.33 milligram/gr leaf wet weight under 70 mm evaporation from E.T pan (second level of drought condition after heading stage) had the lowest one (Table 3)**.**

Table 2 - Correlation coefficients for quality traits of wheat variety and genotypes under drought stress

Measured treat	1	2	3	4	5	6	7	8
1 - carotene	1							
2 - Flavaonoid	0.070	1						
3 - Fenol Tom	0.104	0.868**	1					
4 - Sucrose	-0.090	-0.050*	-0.020**	1				
5 - Fructose	0.006	0.186*	0.441**	0.683 **	1			
6 - Glucose	0.019	0.318**	0.483**	0.396 **	0.750**	1		
7 - proline	0.033	0.215**	0.463**	0.170 *	0.696**	0.726**	1	
8 – grain yield	0.009	0.103	-0.126	0.125	-0.148*	-0. 131*	-0.148 *	1
*, **: Indicate significant differences at levels 0.05 and 0.01 level respectively.								

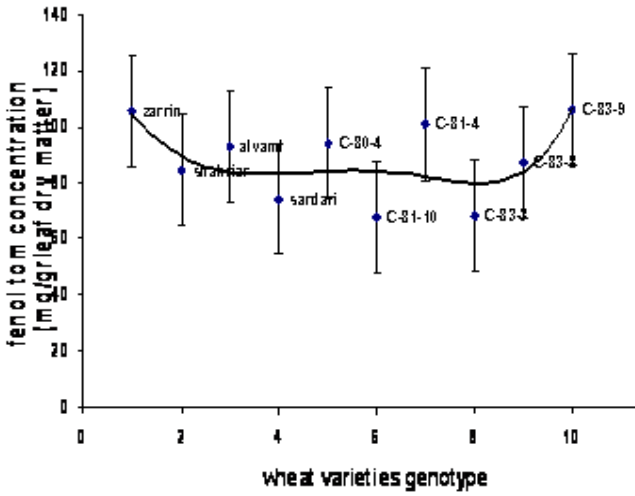

Figure 3 - Means of fenol tom content in 10 wheat varieties and line in irrigation after heading stage

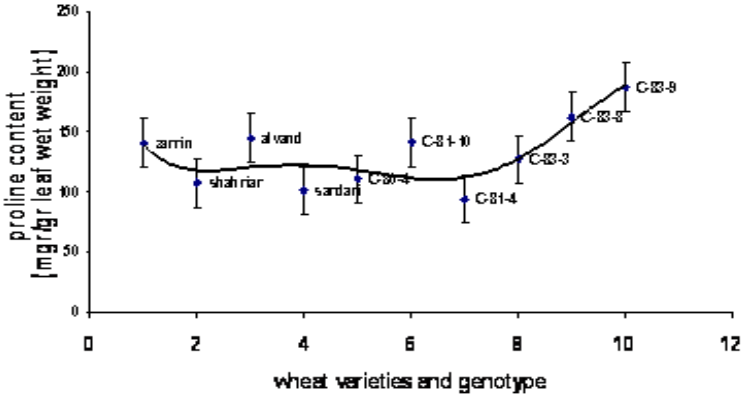

Figure 4 - Means of proline content in 10 wheat varieties and line in irrigation after heading stage

Table 3: Mean treat of wheat genotypes and variety under drought stress level on farm condition

Irrigation level	Wheat variety	Wheat variety and genotypes physiological treat							
		Carotene milligram / gr leaf DW	Flavonoid milligram/ gr leaf DW	FenolTom milligram/ gr leaf DW	Sucrose milligram/ gr leaf DW	Fructose milligram/ gr leaf DW	Glucose milligram/ gr DW leaf DW	Proline milligram / gr leaf WW	Grain Yield Ton/he
70 mm evaporation from E.T pan after heading stage	Zarrin	16.44 a-e	13.08 a-d	92.50 d-i	39.33 h-l	56.67 n-p	64.00 o-t	116.8 i-r	6.860 a
	Shahriar	20.08 a	9.554 d-h	78.77 i-m	26.25 o	38.00 tu	48.00 st	72.67 rs	6.579 ab
	Alvand	15.23 a-f	10.90 a-f	84.37 h-l	29.67 m-o	38.33 s-u	68.67 n-s	118.7 h-q	6.059 a-f
	Sardari	16.21 a-e	6.726 g-j	63.13 n-q	27.83 no	37.67 tu	55.00 q-t	72.33 rs	3.178 kl
	C-80-4	12.85 c-f	10.74 a-f	87.73 f-k	38.33 h-m	48.67 p-t	52.00 r-t	77.67 q-s	6.389 a-c
	C-81-10	15.04 a-f	5.517 j	56.43 q	32.00 k-o	39.00 s-u	90.67 j-n	106.7 j-s	6.238 a-d
	C-81-4	14.08 b-f	13.30 a-c	95.40 d-h	43.33 g-j	53.67 n-q	96.67 i-m	69.33 s	5.537 b-g
	C-83-3	12.81 c-f	5.893 ij	59.37 o-q	62.50 b-d	73.00 i-l	43.33 t	93.67 m-s	5.987 a-f
	C-83-8	16.26 a-e	8.534 f-j	77.03 j-n	64.67 bc	77.00 g-j	110.7 f-k	128.7 g-o	6.170 a-e
	C-83-9	13.67 c-f	13.65 ab	96.03 d-h	55.33 d-f	76.67 g-j	107.7 g-k	139.7 f-k	6.269 a-d
100 mm evaporation from E.T pan after heading stage	Zarrin	10.02 f	12.29 a-e	94.43 d-h	37.67 i-m	55.67 n-q	64.67 o-t	126.7 g-p	5.564 b-g
	Shahriar	16.47 a-e	8.517 f-j	72.07 l-p	30.75 l-o	36.00 u	47.67 st	83.33 p-s	5.678 b-g
	Alvand	17.96 a-c	10.56 a-f	88.33 e-k	26.25 o	33.67 u	72.67 n-r	126.7 g-p	5.088 kl
	Sardari	14.16 b-f	6.734 g-j	64.73 m-q	29.75 m-o	39.00 s-u	58.67 p-t	79.33 q-s	3.142 kl
	C-80-4	12.77 c-f	11.36 a-f	90.13 e-j	35.00 i-o	50.00 p-s	60.33 p-t	83.70 p-s	5.945 a-f
	C-81-10	14.73 a-f	5.912 ij	58.43 pq	34.50 j-o	41.67 r-u	94.67 j-m	139.00 f-l	5.230 c-h
	C-81-4	13.00 c-f	13.65 ab	98.07 d-h	51.33 e-g	59.00 m-p	102.7 h-l	75.00 q-s	5.975 a-f
	C-83-3	14.11 b-f	5.361 j	58.03 pq	63.75 b-d	77.00 g-j	57.33 p-t	97.33 k-s	5.031 e-i
	C-83-8	15.23 a-f	9.588 c-h	77.00 j-n	63.33 b-d	77.67 g-j	105.3 g-l	140.3 f-k	5.350 c-g
	C-83-9	13.71 c-f	14.15 a	98.07 d-h	61.88 b-d	87.00 f-h	96.00 i-m	155.0 e-i	5.264 c-h
130 mm evaporation from E.T pan after heading stage	Zarrin	15.76 a-f	12.26 a-e	115.2 a-c	43.50 g-j	73.50 i-l	84.00 l-o	138.0 f-m	4.125 h-k
	Shahriar	13.93 b-f	9.34 d-i	84.53 h-l	3308 k-o	44.67 q-u	52.00 r-t	91.67 n-s	3.490 kl
	Alvand	14.33 a-f	11.42 a-f	97.40 d-h	31.67 k-o	58.00 m-p	95.33 j-m	133.3 g-n	3.809 j-l
	Sardari	15.28 a-f	6.867 g-j	73.87 k-o	40.33 h-k	52.00 o-r	70.00 n-s	88.00 o-s	3.157 kl
	C-80-4	16.41 a-e	11.92 a-f	99.43 d-h	40.00 h-l	59.33 m-p	79.00 m-p	94.63 l-s	4.764 g-j
	C-81-10	12.58 c-f	6.331 h-j	65.53 m-q	44.00 g-i	64.33 k-n	120.3 e-h	148.3 e-j	5.031 e-i
	C-81-4	17.79 a-d	13.35 ab	106.7 b-d	58.33 c-e	75.33 h-k	126.00 d-g	84.00 p-s	4.128 h-k
	C-83-3	14.63 a-f	6.041 h-j	69.47 m-q	74.08 a	97.00 ef	77.00 m-q	105.7 j-s	4.126 h-k
	C-83-8	15.10 a-f	10.82 a-f	94.40 d-h	73.00 a	104.00 de	133.3 c-e	154.0 e-i	4.764 g-j
	C-83-9	17.07 a-d	11.95 a-f	108.1 b-d	61.75 b-d	102.3 e	121.7 e-h	180.1 c-f	5.202 d-h
170 mm evaporation from E.T pan after heading stage	Zarrin	13.44 c-f	11.75 a-f	119.4 ab	26.33 o	81.33 g-i	96.33 i-m	180.9 c-f	3.999 i-l
	Shahriar	17.80 a-d	11.53 a-f	103.1 c-f	25.83 o	63.00 l-o	90.00 k-n	181.3 c-f	3.777 j-l
	Alvand	14.83 a-f	12.48 a-e	101.00 c-g	28.00 no	68.67 j-m	113.00 e-j	201.0 b-d	3.449 kl
	Sardari	11.96 d-f	10.22 b-g	95.22 d-h	37.83 i-m	76.33 h-j	111.3 e-k	163.0 d-h	2.9451
	C-80-4	16.36 a-e	12.68 a-e	100.1 d-h	36.00 i-n	82.33 g-i	118.3 e-i	186.0 b-e	3.853 j-l
	C-81-10	13.08 c-f	9.313 e-i	90.67 e-j	40.08 h-l	88.33 fg	144.7 b-d	169.3 c-g	5.341 c-g
	C-81-4	15.72 a-f	11.64 a-f	103.8 c-e	47.33 f-h	113.3 cd	149.7 a-c	147.0 e-j	4.152 h-k
	C-83-3	14.76 a-f	6.947 g-j	86.60 g-l	62.83 b-d	126.7 ab	130.3 c-f	210.3 bc	4.018 i-l
	C-83-8	10.67 ef	10.98 a-f	100.8 c-g	67.67 ab	116.3 bc	160.3 ab	225.7 b	4.756 g-j
	C-83-9	19.61 ab	13.87 ab	122.5 a	51.58 efg	135.00 a	166.0 a	274.7 a	4.919 f-j

Value with the same superscript letters are non significantly different at P <0.01.

Regardless of variety and genotype the high average of proline concentration were seen in high evapotranspiration rate in this study and 170 mm evaporation from E.T pan demonstrate that the osmoregulator had up regulated and approximately all genotype in comparison of their situation in non stress or lower stress with stress condition were showed that the proline amount up regulated (Figure 4). Thus, many plants accumulate one or more types of compatible solutes, such as proline or glycine- betaine, in response to low ψ_w, salinity, freezing and other abiotic stresses that alter water status. These and other similar solutes are termed compatible solutes because they can accumulate to high levels without interfering with metabolism [35] and may also have other protective properties. Osmotic adjustment and accumulation of compatible solutes can be an important factor in drought tolerance in the field [21], and engineering of increased synthesis of compatible solutes is one approach that has been taken to increase abiotic stress tolerance in plants [5]. The trade-off in this case is that increased accumulation of compatible solutes can be energy and resource intensive for the plant, and, in cases of severe stress where soil water content is largely depleted, may have only a small effect on water uptake [21].

Grain yield

The most widely used criteria for selecting high yield performance are mean yield, (average yield performance under stress and non stress conditions) and relative yield performance in drought-stressed and more favorable environments [29]. Zarrin (6.860 ton/ha) variety under normal condition (70 mm evaporation from E.T pan conditions) have the highest grain yields and sardari (2.945 ton/ha) at 170mm evaporation from E.T pan conditions was the lowest value (Table 3). Sardarri one of the prevalent varieties in Iran dry farming and this average of production were normal but in this study we were looking for the new high performance variety and C-81-10 with high concentration of proline in 170 mm evaporation from E.T pan after heading irrigation had the highest yield between the varieties in the same situation. High grain yield under stress couldn't express tolerant genotype, because it may be have mechanism escape from the stress and/or have high grain yield potential. Moreover, the genotype may perhaps had tolerant gene but had the low grain yield potential, and opposite genotype may have high grain yield potential but have high reduction percent under stress**.** Result of correlation coefficient analyse showed that the C-83-9 that had the highest proline amount did not range in high yield performance variety (Table 2) result showed high negative correlation between proline content and grain yield (r^2= - 0.148) ($p<0.05$) in this study evaluation of different traits like relative yield of genotypes under drought stress and non stress conditions is a starting point to identify drought tolerance and to select genotypes for reformation in dry regions [13]. When we were saw the result of proline concentration and in compared With the grain yield result it was very clearly showed that the high resistance variety and genotype had the highest level of proline content in their leaf tissue. Grain yield were affected by photosynthesis rate of crop and it was depended dependent on water light harvesting by organic complex like carotenoids and xanthophylls. Synthesis of lipids and pigments such as chlorophyll, xanthocynin and carotenoid is interrupted by water stress, and dues the high grain yield variety and genotype should have the molecular defensive mechanism as shown in this phase

REFERENCES

[1] Agawal. S.B., D Rathore. 2007. Changes in oxidative stress defense in wheat (Triticum aestivum L.) and mung bean (Vignaradiata. L) Cultivars grown with and without mineral nutrients and irradiated by supplemental ultraviolet- B, Environ. Exp. Bot. 59: 21-33.

[2] Akıncı. S., and D. Losel M. 2009. (A). the soluble sugars determination in Cucurbitaceae species under water stress and recovery periods. Adv. Environ. Biol. 3(2): 175-183.

[3] Akıncı. S., and D. Losel M. 2010. (B). the effects of water stress and recovery periods on soluble sugars and starch content in cucumber cultivars. Fresen. Environ. Bull.19 (2): 164-171.

[4] Andrew J.S., H. Moreau., M. Kuntz., G. Pagny., C. Lin., S. Tanksley., and J. Mc Carthy. 2008. An investigation of carotenoid biosynthesis in Coffee canephora and Coffee arabica. J. Plant Physiology. 165: 1087- 1106.

[5] Apse. M. P., and Blumwald E. 2002. Engineering salt tolerance in plants. Current Opinion in Biotechnology. 13: 146-150.

[6] Bates. S. 1973. Rapid determination of free proline for water stress studies. Plant and Soil Science. 39: 205-207.

[7] Chang. C. C., M. H Yang, H. M. Wen., and J. Chern C. 2002. Estimation of total flavonoid content in Propolis by two complementary colorimetric methods. Journal of Food and Drug Analysis. 10: 178-182.

[8] Chaves. M. M., J. Maroco P., and J. S. Pereira. 2003. Understanding plant response to drought from genes to the whole plant. Functional Plant Biology 30: 239-264.

[9] Chaves. M. M, and M. M. Oliveira. 2004. Mechanisms underlying plant resilience to water deficits: prospects for water-saving agriculture. Journal of Experimental Botany. 55: 2365-2384.

[10] Dadbakhsh A., A. YazdanSepas. 2011. Evaluation of drought tolerance indices for screening bread wheat genotypes in end-season drought stress conditions. Adv. Environ. Biol. 5(6): 1040-1045.
[11] DellaPenna. D, and B.J. Pogson. 2006. Vitamin synthesis in plants: tocopherols and carotenoids. Annual. Rev. Plant Biol. 57: 711-738.
[12] Farooq. M., A.Wahid., N. Kobayashi., D. Fujita., and SMA. Basra. 2009. Plant drought stress: effects, mechanisms and management. Agronomy Sustain Dev. 29: 185–212.
[13] Farshadfar. A., M. Zamani., M. Matlabi., and A. Imam Jome. 2001. Selection for drought tolerance in pea lines. Iranian Agriculture Science Journal. 32: 65-77.
[14] Flowers. T. J., P. F. Troke., and A. R. Yeo. 1977. The mechanism of salt tolerance in halophytes. Annual Review of Plant Physiology. 28: 89-121.
[15] Garcia Del Moral L. F., Y. Rharrabti., D. Villegas, and C. Royo. 2003. Evaluation of yield and its components in durum wheat under Mediterranean conditions: An ontogenic approach. Agronomy Journal. 95: 266-274.
[16] Hanson. A. D., and W. D. Hitz, 1982. Metabolic responses of mesophytes to plant water deficits. Annual Review. Plant Physiology. 33: 163-203.
[17] Kao. C.H.1981. Comparative study of the metabolic changes of senescing turgid and water stressed excised leaves. Plant and cell physiology. 22:683-685.
[18] Kiani. S. P., P. Maury., A. Sarrafi., and P. Grieu. 2008. QTL analysis of chlorophyll fluorescence parameters in sunflower (Helianthus annuus L.) under well-watered and water-stressed conditions. Plant Science. 175: 565-573.
[19] Kirk. J. T. O, and R.L. Allen. 1965. Dependence of chloroplast pigment synthesis on protein synthesis: Effect of acsidione. Biochemistry and Biophysics Research. 21: 530-532.
[20] Koyama. Y. 1991. Structures and functions of carotenoids in photosynthetic systems. Journal of Photochemistry and Photobiology. l9: 265-280.
[21] Kramer P.J., and J.S. Boyer. 1995. Water Relations of Plants and Soils. San Diego: Academic Press.
[22] Liang. B., X. Huang, G. Zhang., Q. Zhou. 2006. Effect of Lanthanum on flavonoid contents on soybean seedling exposed to supplementary ultraviolet-B radiation. Journal of Rare Earths. 24 (5): 613- 616.
[23] Li. L., J. Van Staden., and A. K. Jager. 1998. Effects of plant growth regulators on the antioxidant system in seedlings of two maize cultivars subjected to water stress. Plant Growth Regulature. 25: 81-87.
[24] Martin. m., F. Micell., J. A. Morgan., M. Scalet., and G. Zerbi .1993.synthesis of osmotically active substances in winter wheat leaves as related to drought resistance of different genotypes. Journal of Agronorny and crop science. 171:176-184.
[25] Morgan. J. M. 1984. Osmoregulation and water stress in higher plants. Annual Review. Plant Physiology. 35: 299- 319.
[26] Moran R., D. Porath. 1980. Chlorophyll determination in intact tissue using N, N1- dimthyl form amide, Plant Physiology. 65 (4): 478-479.
[27] Perez. A. G., C. Sanz., D.G. Richardson., and J. M. Olías. 1993. Methyl jasmonate vapor promotes β-carotene synthesis and chlorophyll degradation in Golden Delicious apple peel. Journal of Plant Growth Regulature. 12: 163-167.
[28] Pessarkli. M. 1999. Hand book of plant and crop stress. Marcel Dekker Inc. 697 pages.
[29] Rashid. A, Q. Saleem., A. Nazir., and H. S. Kazım. 2003. Yield potential and stability of nine wheat varieties under water stress conditions. International Journal of Agriculture and Biology 5(1):7-9.
[30] Reddy., A. R., K.V. Chaitanya., and M. Vivekanandan. 2004. Drought induced responses of photosynthesis and antioxidant metabolism in higher plants. Journal of Plant Physiology. 161: 1189-1202.
[31] Sheveleva. E., W. Chmara., H. J. Bohnert., and R. G. Jensen. 1997. Increased salt and drought tolerance by D- Ononitol production in transgenic *Nicotiana tabacum* L. Plant Physiology. 115: 1211- 1219.
[32] Siefermann. D., H. Harms. 1987. The last harvesting and protective function of carotenoids in photosynthetic membranes. Plant Physiology. 69 (6): 51-568.
[33] Shahryari. R., V. Mollasadeghi. 2011. Introduction of two principle components for screening of wheat genotypes under end seasonal drought. Advance Environmental Biology. 5(3): 519-522.
[34] Tanaka. R., U. Oster., E. Kruse., W. Rüdiger., and B. Grimm. 1999. Reduced Activity of geranylgeranyl reductase leads to loss of chlorophyll and tocopherol and to partially geranylated chlorophyll in transgenic tobacco plants expressing antisense RNA for geranylgeranyl reductase. Plant Physiology. 120: 695-704.
[35] Yancey. P. H., M. E. Clark., S. C. Hand., R. D. Bowlis., and G. N. Somero. 1982. Living with water stress: evolution of osmolyte system. Science. 217: 1214-1222.
[36] Zobayed. S. M. A., F. Afreen., and T. Kozai. 2007. Phytochemical and physiological changes in the leaves of St. John's worth plants under a water stress condition. Environmental and Experimental Botany.59: 109-116.