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Investigating the Effects of Drought Stress of End of Season on Performance of Storage, of Photosynthesis and Genotypes of Durum Wheat in Ahwaz

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ABSTRACT: Potentiality of storing materials in stalk and yield of Remobilization them to seed in crops, specially under the condition of drought stress, are among the fundamental elements of determining and an analyzing differences of performance of different species and varieties of agriculture. In order to do this, an experiment was done using split plots in format of completely random blocks, repeated 3 times, in two conditions: ideal watering condition and drought stress, in agricultural researches farm in Ahwaz, in 1389-90. In this experiment, main factor included two conditions of watering (without stopping watering, stop watering in the time of seed filling) minor factor included genotype of Durum wheat in five levels, including Karkheh, Dena, Behrang, D-84-6, D- 84-9. Results of the experiment showed that drought stress decreased performance and parts of performance in investigated items, comparing to moralized watering conditions with respect to yield of re-transferring and amount of stalk storage among the investigated items, Behrang had the most yield and amount of stalk storage, which this amount had a significant difference with most of the items. Also, it could be seen in the research that the most amount of stalk storage in a bout lower nodes, which is a bout two times more than storage of pdank and pnaltymykin analyzed items according to this results, it could be said that Behrang is a more appropriate item for growing in dry areas like Ahwaz, because it has more yield comparing to other items in condition of stress and it also has more ability to absorb photosynthetic materials in plants" vegetative organs.

Keywords: drought stress, photosynthetic materials, Durum wheat, yield.

INTRODUCTION

Iran has hot and dry climate and drought is one of the most important challenges which limits yield, specially in tropical areas. (Abdulai *et al.,* 2008) on the other side, drought is one of the most important threats of the world for producing food staffs, furthermore, changes in weather and increases for world's population have expanded the problem one of the solutions for the problem is creating new items which have more resistance against drought stress (Talked and Matsuoka., 2008). Increasing yield under drought stress condition, needs genotypes which are resistant and it also needs management for minimizing available water. Periodical drought stress in critical stages of grains, decreases the yield (Bdulai *et al.,* 2008). In grains, specially wheat, in. period of growth, gathering of dry material in plant is more than its need to grow. In this situation, extra photosynthetic materials would be stored in stalk as different sugars, and in other stages of growth, which usually start from two to three weeks after flowering, they would be transferred to seed (Sabry *et al.,* 1995) so, it could be mentioned that there are two carbohydrate sources in making photosynthetic materials in the time of seed filling. One is the products of current photosynthetic materials which are remobilization to seed directly and the other is re-producing photosynthetic materials which were stored in stored tissues. they produce materials in the dark nights and also at the end of seed filling. In this period, activities of photosynthetic organs decrease relatively and the speed of gathering of dry material in seeds is more than its speed in the whole plant (Schnyder, 1993). The purpose of the study is analyzing the effects of drought stress of end of season on performance of storage, Remobilization of photosynthesis and different performance genotypes of Durum wheat in two conditions: dry farming and complimentary irrigation (watering). This study tried to use these conditions and according to them, tried to choose the best genotypes, which have the highest yield in these two conditions.

MATERIALS AND METHODOLOGIES

A study was conducted in 1389-90 in agricultural research station in Ahwaz, which is controlled by the center of agricultural researches of Khuzestan.

This is located in geographical longitude 3ll6ll5 and geographical latitude 48/25/22 and latitude of 12 meters from sea level. Lands of this area usually have clay ten tare and their ptl is a bout 7-7/5, saltiness, bout 4-13 dz in drained parts. Considering organics and azotes, they are poor this area's climate is dry and semiarid and it has hot and long summers, and moderate and short winters. Its average temperature in year is 13/2 cg and its average rain tall is 213 mm. In this study 10 treatments were used as split plot in format of random blocks, in 3 intervals treatment of main plot were in two levels of irrigation: without stopping the irrigation and stopping irrigation in the stage of grain filling. Secondary treatment include Durum genotype. Wheat in five levels, including Karkheh, Dena, Behrang, D-84-6 and D-84-9.

Operation of planting seeds was done on 21 of Aban. In the study ideal irrigation for plant's need was done, in away that irrigated and stress plots were irrigated simultaneously. After this stage, irrigation stress plot stopped, while Watering plot were irrigated till the end of growing stage. At this time, these stress plot were irrigated 7 and 11 times, respectively. For sampling in the time of pollinating plants were cut randomly from each plot and in laboratory stalks of each genotype were divided into 3 parts: Pdank penalty peduncle and lower inter node. The organs were dried with 70 cg and then distributed carefully: sampling was done when of seeds getting milky and physiologic and drought for all kinds of cultivated items. The amount of re-transferring of photosynthetic materials are gained using extra weight of each intern ode, when it has its maximum weight and its physiological completeness. Yield of re-transferring is gained using calculation of transferred materials to their maximum averaged weight (Ehdaei *et al*, 2006). Re-transferring of stored of stored materials from stalk to seed is gained using these formulas: dry stalk weight at seed maturity-the maximum dry stalk weight after pollination = re-transferring of stored materials from stalk to seed. Dry stalk weight at seed maturity-maximum spike dry straw after pollination = re-transferring of stored materials from spike straw to seed. 100 × (maximum dry stalk weight after pollination / re-transferring of stored materials from spike straw to seed = yield of spike in transferring stored materials to seed (%). Re-transferring of dry materials from stalk and spike to seed-seed yield = current photosynthesis. 100 × (seed yield current photosynthesis) = relative contribution of current photosynthesis in yield ency 100 × (seed yield / re-transferring of stored materials from stalk to seed) = relative contribution of stem reserves in yield. 100 × (seed yield / re-transferring of stored materials from spike straw to seed) = relative contribution of spike reserves in yield (%). In the time of maturity, a square meter yield and parts of yield. In order to analyze data's variance, we used SAS soft wore. LSD was used to compare means.

RESULTS AND DISCUSSION

Results of analyzing and variance of feature number of spikes in each square meter showed that of number at 1% level was significant and other sources had no significant change (Table 1). This feature is one of parts of seed yield which depends on density of cultivation and tillering of item. Comparing means of numbers of spikes in different wheat kinds showed a significant difference between the items. Impacts of irrigation and drought stress and their effects on each. There were not significant, because stress was after pollination. The results showed that were not significant, because stress was after pollination. The results showed that highest number of spikes in unit of area was Behrang with 412 spikes in each square meter and D-84-9 with 3/2/96 spikes in each square meter had the minimum spikes According to the classification, Dena and D-84-6 are at the same class in the number of their spikes. this shows there is no significant difference between these two items in the number of spikes in each square meter (Table-z) the results agree with the results of a research by Zore Feizabadi and Ghods (1381), in which they analyzed drought resistance of wheat's. Their research showed that yield of seeds which are resistant to drought at the end of season is more than sensitive items like Mahdavi and m-73-20.

A. Number of seeds in spike

Number of seeds in spikes is affected by conditions of irrigation and it has no significant difference in the study, But this feature was affected by item factor and effects of item and irrigation situation, which had a significant different (Table 1). Results of the study showed that the highest number. Number of seeds in spikes was 35/90 for D-84-9 with normal irrigation and the number spikes in this item had not significant difference in both conditions. but it difference with other treatments was significant (Table 2). Khezri and co-workers (1388) reported that number of seeds in spikes was affected by irrigation condition and dry farming and had a positive correlation with seed yield in the level of one percent. Also, Senjari (1381) investigated different items of wheat and morph physiological indicators of resistance for drought in new wheat items, under water shortage situation. They reported that seeds decrease of yield was due to drought stress which had relation with number of seeds in spike.

Table 1: Analysis of variance of number of seeds in spike weight of 1000 seeds, seed yield, biological yield and harvest-indicator.

	df	Hi	BY	GY	TKW	Seed.m^{-2}
Replication	2	14/23	242442/6	34376/7	0/616	1/23
Irrigation	1	572/03**	6944678/5*	12578982/5**	573/78**	10/8^{ns}
Error a	2	5/83	535042/4	18130/2	0/702	0/27
Variety	4	34/33**	14442743/3**	2136073/25**	11/94**	47/45**
a×b	4	11/87**	729948/8**	361718/62**	14/01**	0/63**
Error b	8	1/83	127620/2	13610/76	0/706	0/123
CV	-	3/54	3/44	2/95	2/52	1/1

ns, * And ** show that there was no significant difference and was a significant difference at 5 and 1 level, respectively

Seed. m^{-2}, TKW, GV, BY and Hi are abbreviation for number of seeds in spike, 1000 seeds weight, seed yield, biological yield and harvest indicator, respectively

B. 1000 seeds weight

investigating treatments showed that item factor, irrigation condition and reciprocal effect had a significant different at one percent level, on 1000 seeds weight (Table 1) According to the table of means, it could be seen that the highest weight of 1000seeds equaled 40 gm and there was a significant difference between this item and other items, except Karkhe item (Table 3). Also, according, the highest weight of 1000 seeds equal 31/5 grams and is for D-56-6 treatment. Decreasing of 1000 seeds in most of items in drought stress, showed that there was not enough photosynthetic materials for stores in that condition, Reaction of items according to 1000 seeds weight showed different sensitivity and resistance to drought stress. Sing and Patil (1996) investigated drought stress effects in different stages and reported that seed yield and time of seed filling is effected by drought stress, Also, they mentioned that after filling the number of seeds in pollination stage, seeds weight was the most important factor in determining wheat yield. Farshadfar and Mohammadi (1385) in an investigation mentioned that according to drought stress of genotypes of bread wheat, 1000 seeds weight and yield and most of analyzed features, the two conditions of stress and stress free had significant differences which showed different reactions of wheat genotypes comparing to dry treatment Table 2.

Table 2: comparing average of reciprocal effects of 1000 seeds in spike m 1000 seeds weight, seed yield, Bio yield and harvest indicator.

(%)Hi	BY(kg/ha)	GY (kg/ha)	TKW (gr)	Seed.m^{-2}	Treatment
					Normal
42/33bc	12150b	5128b	38/77a	32 c	Karkhe
41/33cd	9434f	3869d	36/33b	31/03 d	Dena
45/33a	12650a	5700a	40a	34/2 b	Behrang
39/67d	11100d	4394c	36/73b	29/27 f	D-84-6
44ab	8919g	3942d	36/6b	35/9 a	D-84-9
					Stress
33/67e	10090e	3394ef	27/33e	31/17 d	Karkhe
31/33e	8403h	2609g	25/67f	29/93 e	Dena
33e	11750c	3858d	29/2d	32/43 c	Behrang
31/67e	10940d	3472e	31/5c	27/33 g	D-84-6
39/33d	8256h	3224f	31c	35/53 a	D-84-9

Similar letters in each column show there is no significant difference at level 5.

C. Seed Yield

According to analysis table of variance, it was clear that effects of item factor, irrigation condition and reciprocal effects on seed yield at stage of one percent, was significant (Table 1).

According to the table of reciprocal effects of different wheat items and irrigation condition, we could see that the highest yield of seed was 5700 kg in hektar and was gained by Behrang under normal irrigation.

The difference between this treatment and others was significant. Under the condition of highest drought stress the highest amount of harvest was for Behrang. A lot of researchers analyzed the reason of seed in-yield in wheat under drought stress condition. They mentioned the reasons were fast aging of leaves (decrease in power source) and decrease in photosynthesis speed (Ahmadi and others, 2009, Yung and Zang 2006). In a study on different items of wheat, it was reported that drought stress decreases growing season and specially duration of seeds fillings and finally decreases wheat items yield. Also, they mentioned that drought stress has a significant effect on seed yield in differ rent items of wheat (Asodpur, 1385).

D. Biological yield

Results of the study's analysis and variance showed that biological performance is affected by item factor and reciprocal effects of irrigation situation. Item factor had a significant. Difference at once percent stage and the effects of irrigation situation on biological performance at stage 5 was significant (Table 1). According to the results of comparison of means we could see that the highest biological performance in normal irrigation belonged to Behrang, which was 12650 gm in square meter. This treatment had a significant difference with other treatments. The minimum amount of biological performance equaled 8256 in square meter for D-84-9 which was in drought stress condition. Its difference with Dena was not significant in drought stress condition, but its difference with other treatments was significant. in drought stress, the highest amount of harvest was for Behrang which had a significant difference with. There treatments were significant. In drought stress, the highest amount of harvest was for Behrang which had significant differences with. There treatments (Table 3). According to Ghods and others (1382). According to Ghods and others (1382) moisture stress. decreases biological performance, which confirms our study 's results. In a study on genotypes of different wheats (breat wheat) under drought stress, it was recorded that seed performance (yield), 1000 seeds weight, harvest indicator and performance of biomass are effected by drought stress, significantly, It was also mentioned that increasing of drought stress, specially in the sensitive stage of seed filling, like pollination and seed filling, decreases the process of the seed (Dastfal *el al.*, 1388).

E. Harvest Index

Results the analysis table and variance showed that the effect of item irrigation condition and reciprocal effects of these factors on Harvest Index at level of one percent is significant (Table, 1), comparing means of reciprocal effects showed that the highest Harvest Index in normal irrigation was for Behrang which was 45/33 and this treatment showed significant differences with other treatments, except B-84-9. The minimum a mount of HI was 31 percent for Dena, under drought stress. this number had no significant difference with karkhe Behrang and D-84-6 under drought stress and they all belong to one class-In drought stress the highest HI was D-84-9 which its difference with other treatment was significant (Table 3) Most of genetic improvements a bout phyisiological features of wheat show positive relation between seed yield and Harvest Index and correlation between seed performance with Biomass was reported to be weak and there is no relation between them (Salafar and others, (1994).

Table 3– Analysis of variance relate to re-transferring of nodes yield of re–and amount of nodes resourses.

		Resourses contribution (%)			Re–transferring performance (%)			Re-transferring (gr/m²)		
	df	Zirin	pnalty	pedank	Zirin	pnalty	pedank	Zirin	pnalty	pedank
Replication	2	0/09	0/07	0/053	5/97	9/07	9/66	0/561	0/432	0/505
Irrigation	1	0/063 ns	0/939 *	0/481*	151/11*	547/07*	332/2*	21/72*	34/66*	22/63*
Error a	2	6/71	2/428	2/22	4/79	7/51	7/98	0/6	0/448	0/49
Variety	4	2/26**	0/983**	1/04**	138/85**	162/84**	179/44**	66/09**	28/79**	30/55**
a×b	4	0/31**	0/020**	0/24**	48/73**	59/97**	66/01**	7/45**	4/06**	4/81**
Error b	8	0/168	0/074	0/08	6/83	6/95	7/61	1/01	0/45	0/523
CV	-	0/09	0/07	0/053	6/22	7/09	8/09	6/27	7/08	8/09

ns, * And ** show that there was no significant difference and was a significant difference at 5 and 1 level, respectively

F. Re-transferring

As the table 3 shows, effect of treatments of irrigattion on re-transferring of Faryab and Pedank and under-nodes at stage of 5 percent and effect of item treatment and reciprocal effect of these two factors at level one percent, was significant. The table of reciprocal effects irrigation condition different items of wheat show that the minimum and maximum amount of re-Remobilization are for sub-nodes (under-niodes) and pedank, and the highest re-transferring is 23/17 gm in square meters for sub-nodes which gained from Behrang, under normal irrigation condition and this number has significant difference with other items.

In the case of re-Remobilization meet penalty and pedanks are of lower ranges. The minimum amount of re-transferring is 5/6 gm in square meter for D-84-6 under drought stress condition, which is at the same class and have no significant difference (Table 4). The amount of re-transferring among different items and irrigation treatment are different and their amount in normal irrigation was more than drought stress. Results of the study confirm Judi (1389) results In a condition in which photosynthesis decreased because of the amount of dry material gathered in seed, other processes for making up shortage of current photosynthesis, i.e. movement and transfer of materials from vegetative organs to seed, would be activated and somehow make up for shortage of seeds weight (Ginit, 1994). The ability for saving photosynthetic materials is mentioned as an important and impressive factor on re-Remobilization (Ahad and others, 2006). Palta and others (2004) reported that under drought stress condition, the amount of re-transferring would be less than Faryab condition and the reason for such a reaction is presence of stored materials of stalk in adjusting and absorbing water. Different stresses including moisture stress in seed filling stage, effect current photosynthesis, and at this time re-Remobilization of stalk's storages as an important factor can make up for the shortage of seed performance (yield) (Rio and Blanko 1999). In a study on different items of wheat under drought stress, it was mentioned that re-transferring of photosynthetic materials from the season node, was more than drought stress, in all item, in normal irrigation situation.

G. Re-transferring performance

the table of analysis and variance show that the effect of irrigation treatment on re-transferring of pedank meet penalty and under-nodes at stage of 5 percent and effect of treatment items and reciprocal effect of treatment items and irrigation condition on this feature, is significant at lever 1 percent (Table 3): According to table of comparing means we could see that the highest amounts of yield for re-transferring were for under-nodes, meet penalty, penank and they were 53/20, 50/56 and 4/47 respectively, which gained in normal irrigation and from Behrang. This item has a significant difference with other items. the minimum amount of yield in re-transferring is for pedank which is 22/74 percent which gained from D-84-6 under drought stress condition. The difference of this item with Dena, under drought stress is not significant, but with other items, in two conditions of stress and normal irrigation has a significant difference (Table, 4). Also, it is seen that in the case of re-transferring of Dena karkheh and D-84-9, in normal irrigation, they are at the same class and have no significant difference (Table 4). Tusi and Ghanadha (1385) in a study on re-transferring of dry material to seed in difference items of wheat, under normal irrigation situation and drought stress, mentioned that drought stress has sidnificant effect on re-transferring yield (performance) of materials from stalk's nodes to seed. Also, They mentioned that the amount of re-transferring of materials is more in normal irrigation than drought stress. In a study on wheat, it was mentioned that yield of re-transferring is the second important part of contribution of stored materials, in wheat seed performance.

Table 4: Comparing means of reciprocal effects of re-transferring of nodes, yield of re-transferring of nodes and their storages.

Resourses contribution (%)			Re–transferring performance (%)			Re-transferring (gr/m²)			Treatment
Zirin	pnalty	pedank	Zirin	pnalty	pedank	Zirin	pnalty	pedank	
									Normal
3/66cd	2/28c	2/12cd	44/07b	41/28bc	37/23b	15/67cd	9/78bc	9/4bc	Karkhe
4/56ab	2/85ab	2/68ab	44/77b	42/01b	38/01b	15/1de	9/45bcd	8/85cd	Dena
4/70ab	3/00a	2/90a	53/20a	50/56a	47/47a	23/17a	14/77 a	14/27a	Behrang
3/45cd	2/11c	1/90dc	38/12cd	35/03d	30/55c	13/60ef	8/33d	7/52d	D-84-6
4/68ab	2/90ab	2/67ab	41/10bc	38/15bcd	33/87bc	16/85cd	10/43bc	9/59bc	D-84-9
									Stress
4/11bc	2/36c	2/33bcd	45/23b	38/91bcd	36/95b	16/08cd	9/22d	9/07bc	Karkhe
3/99bc	2/08c	1/97cde	34/81de	27/28e	24/95d	11/75f	6/14e	5/82e	Dena
4/37ab	2/47bc	2/42abc	43/20b	36/65cd	34/61bc	18/ b81	10/64b	10/41b	Bchrang
3/09d	1/58d	1/48e	32/88e	25/14e	22/74d	11/73f	5/98e	5/6e	D-84-6
5/02a	2/87ab	2/81ab	42/70bc	36/65cd	34/61bc	17/51bc	10/02bc	9/8bc	D-84-9

The same letters in each column show no significant difference at stage 5. LSD = %5*

I. Resourses (storages) contribution

The table of analysis and variance shows the effect of irrigation treatment on storages of penalty at stage of 5 percent and reciprocal effects of irrigation treatment of items and irrigation condition on the feature, at level of

1 percent, is meaningful and also we can see in the table that amount of storages of under-nodes in irrigation treatments is not significant (Table, 3). According to table 4, the highest contribution of stor ages of under-stalks was 5/02 percent from D-84-9, under drought stress centrally, contribution (amount) of under-storages in different items of wheat was more in normal irrigation, comparing to drought stress, also, I t could be seen that items of Dena Behrang, D-84-9 in normal irrigation and item of Behrang and D-84-9 in drought stress, do not have significant differences in the case of their under-storages. Investigating the reciprocal effect of irrigation condition and different items of wheat show that the highest amount of storages of penalty under normal irrigation is a bout Behrang with 3 percent, which has a no significant difference with Dena, and D-84-9 in normal irrigation and with D-84-9 in drought stress. The minimum amount of storages of meet penalty is for D-84-6 under stress condition and its difference with other treatments is significant, It also seen that the maximum and minimum amount of pedank storage are for: Behrang under normal irrigation and for D-84-6 under drought stress, they are 2/90 percent and 1/48 percent, respectively, The table shows that D-84-6 under stress condition Palta and others (1994) recorded that under stress condition, the amount of karbon contribution and stored nitrogen in making seed are 64 and 81 percent. the amount of re-transferring of stored materials in stalk or percent of storages of stalk, comparing to general weight of seed, are effected by size of talk, environment, and genotype, (Belam, 1994)

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