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The effect of drought stress on the traits related to the Remobilization of wheat genotype in the cold region of Ardabil

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Abstract

To evaluate storage and Remobilization ability photosynthetic material in 10 variant of wheat and bread, a pilot randomized complete block design was done under optimal conditions and with drought stress at the end of 2012 in the field of Islamic Azad University, Ardabil branch. Characteristics of the amount of Remobilization of material and storage from stem to grain, contribution amount of stem reserves to the grain yield, transfer efficiency of carbohydrates from stem to seed and special weight of stem were measured at physiological maturity. The results of combined variance analysis showed that the effect of the environment (drought), genotypes and interactive effect of genotype on all of the traits showed significant differences at 0.1 levels that implies to the large impact of environment on these characteristics. Results showed that Remobilization amount of stem reserves in stressed environment is significantly more than its favorable environment. Only two types of 10 types had greater efficiency in the transference of carbohydrates in stressed condition. So we can conclude that Remobilization of material in optimal moisture condition plays important role in the grain yield. Contribution amount of stem reserves in stressed condition was variant from %7.3 in cultivar type to %28.75 by Trakya type. In terms of transfer efficiency of carbohydrates Azar-2 figure easy the lowest.

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Introduction

Today, food shortage due to various reasons as environment increment, the lowness of production in the unit area and lack of equitable distribution and consumption of food in the developing and developed countries increasingly illustrated, so that more than 3.1 billion people throughout the world are hungry or malnourished. This is when per hour more than nine thousand people is added to the world population. According to the world conference of the environment, the population of developing countries will be 8.5 billion people by the year 2025. The Iran population will also be between 87 to 93 billion people by the year 14000 according to the research studies. Thus, food production is one the main human concerns. No doubt all of the food needs of human directly or indirectly come from plants. With respect to the limited soil resources in agriculture, high yield compared to the increase in the under cultivation area is more important (Hashemi Dezfouli *et al*, 1999).

However, a high percentage of under wheat cultivation lands in Iran belongs to the rain fed cultivation of this plant (Kazemi Arbat, 1996), and in most of the rain fed wheat grown areas, particularly in areas with Mediterranean climate, grains filling period is affected by a variety of living and non-living environmental stresses. In this areas grains filling stage often coincides with the periods that the increase of environment temperature and decrease of moisture storage of soil leads to the heat and drought stress. The end general results of these stresses are shrinkage of grain weight decrease of thousand of seeds, and yield decrease. Since the two physiological stages, meaning current photosynthesis and Remobilization of accumulated material prior to flowering stage consist the final performance, so this part of performance comes through Remobilization from stem and other organs. That's why, one of the appropriate strategies to archive to the acceptable performance is using physiological; indices including estimating the amount of Remobilization of carbohydrates and estimating their contribution to the wheat yield in stresses state (Tahmasebi, 1999; Naderi and Moshref, 2001).

Because with the existence of environmental stresses, the amount of decreased photosynthesis and the resulting material of photosynthesis are more consumed to the survival of plants, thus current assimilation decreases because of natural aging and the effect of various stresses' hence it is an important source of carbon for grain filling, Remobilization of material from growth parts and stem reserves.

Materials and methods

Test implement location

The test was done in the fall of year 1391 in the farm of Islamic Azad University, Ardabil branch with geographical coordinates of 48 degrees and 30 minutes east longitude and 38 degrees and 15 minutes north latitude with an elevation of 1.350 meters above sea level. The climate of project area was cold semi-arid and has a long dry season, especially in the summer. The soil type of the area was clay loam that is poor considering organic matter and its amount is %7. Under test land in before crop year 41 was in fallow.

Test profile

10 dry-land and irrigated wheat (table1) in the fall of the year 90 were cultivated in a randomized complete block design with three replications under optimal moisture condition and final drought stress in the farm of Islamic Azad University, Ardabil branch. Each plot consists of seven lines spaced 3 meters that cultivation with the density of 300 seeds is done manually per square meter.

Survey of Remobilization indicators

In order to determine the Remobilization amount of dry material to the seed, at the head emergence stage in the main lines several similar plants are marked in each plot and from the emergence of shoot to the physiological maturity once every 5 days, 5 plants from each plot were taken in each stage. The harvested plants were distributed after drying and the traits related to the transfer rate of dry material through proposed relations estimated by Ehsaei (1999):

The traits related to the transfer rate of dry material through proposed relations by Ehdaei (1999) and Shakiba *et al*, (1996) was estimated as follow:

Dry weight of stem at maturity stage, the maximum dry weight of stem after pollination, Remobilization of storage material from stem to grain.

100* (seed weight/ Remobilization of storage material from stem to grain) = contribution amount of stem reserves in grain yield (percent).

100* (maximum dry weight of stem after pollination / (Remobilization of storage material from stem) = efficiency of stem in the transfer of reserves to the seed.

100* (maximum weight of stem/ (the special weight of stem at maturity- maximum weight Special to stem) = efficiency of carbohydrates transfer from stem to seed.

Statistical analysis

Statistical analysis was performed using SPSS software.

Results and discussion

The results of combined variance analysis of surveyed traits showed that the effect of the environment (drought) was significant for all of the traits that are consistent with result of the research which was done by Ahmadi *et al*, (2005). The difference between cultivars is significant at %1 level that indicates to a greater variation between genotype * environment also showed significant difference at %1 probability in terms of all traits which implies to the high impact of the environment to these characteristics (Table 2).

Table 1. Names of used genotypes.

Number	Genotypes	Number	Genotypes
1	Sabalan	6	Siosson
2	Azara2	7	Alamout
3	Fengkang	8	Bezostaia
4	Trakia	9	Garak79
5	Pishtaz	10	Konia2002

Table 2. Mean squares analysis of complex traits related to remobilization of stem reserves to seed

S.O.V	df	Mean of squares				
		Remobilization of stored materials	Contribution of stored materials in stem to grain yield	Eigen weight of stem at maturity	Efficiency to transport Carbohydrates	Stem efficiency to transport stored materials
Environment	1	20148.34**	25.99**	106.94**	335.09**	10.46**
Error	4	6.012	0.025	65.202	0.0042	0.0046
Genotypes	9	40927.2**	154.23**	84.16**	118.98**	96.48**
Genotype × Environment	9	8738.75**	37.68**	4.86**	56.27**	36.38**
Error	46	4.87	0.024	0.092	0.016	0.024
C.V.%		0.74%	1%	1.77%	0.77%	0.79%

Table 3. Effect of drought stress on traits related to remobilization of the 10 studied varieties.

Condition	Remobilization of stored materials (mg)	Contribution of stored materials in stem to grain yield (%)	Eigen weight of stem at maturity(mg/cm)	Efficiency to transport Carbohydrates (%)	Stem efficiency to transport stored materials
Optimal	280.3b	16.26a	16.33b	19 a	28.08a
Drought	316.95a	14.95b	19.01a	14.28b	19.25b

The obtained results showed that the Remobilization amount of stem reserves in stressed environment is significantly more than its optimal environment (table 3) which is consistent with the results of the research done by Zhang *et al*., (2001) and Ahmadi *et al*, (2005) but they are inconsistent with the results of research which was done by Shakiba *et al*, (1996). With respect to the results of table 4 it is seen that 8

of 10 figures have more Remobilization in stressed condition. Despite higher rate of Remobilization of stem reserves in stressed environment compared to normal environment, due to the reduction in spike in stress- bearing environment, seed weight of per tiller was more compared to the favorable environment (data have not been shown) and the contribution of stem reserves was not significantly more than optimal environment in stressed environment. Trait of stem special weight in physiological contribution under optimal condition was significantly lower than stressed condition (table 3). These research findings are inconsistent with the findings of research of Ehdaei (1999), this is probably because of high density in the optimal environment and increase of plant height due to the competition of plants and therefore the cost of length unit has been reduced. Changes of maximum stem special weight also depend on this trend and show the dependence of this trait to the test conditions especially density and culture. For this reason carbohydrates transfer consistency and stem consistency in the reserves transfer that are estimated based on special weight and maximum simple dry weight had significant difference in the drought stress and normal environment. As it is evident in the table 4, only two of ten figures had more efficiency in the transfer of carbohydrates in stressed condition. In the research by Ahmadi *et al*, (2005) only two of four figures had more efficiency in the Remobilization of material to the stem. Thus we can conclude that Remobilization of material in optimal moisture condition plays important role in the seed yield. Contribution amount of stem reserves in stressed situation was varied from %7.3 in stressed situation in cultivar figure to %28.75 in Trakya figure. In terms of carbohydrates transfer efficiency Azar-2 figure had lowest amount. The results of this research showed that the effect of drought stress on the different branches of Remobilization is not the same. Lack of drought effect on some indices can be because of decrease of Esmilat storage due to the resource limitedness or reduction of plant density and finally because of weight increase of seed of per plant under drought stress. Incidence of diseases such as rust that reduce current photosynthesis efficiency in optimal moisture environment can interfere with drought and compensate doughtiness.

Table 4 Comparison of average remobilization traits in 18 studied wheat varieties.

Stem efficiency to transport stored materials		Efficiency transport Carbohydrates (%) to		Eigen weight of stem at maturity(mg/cm)		Contribution of stored materials in stem to grain yield (%)		Remobilization of stored materials (mg)		× environment genotype	
17.95	j	14.40	k	15.40	h	16.90	g	269	l	Sabalan	Normal
17.45	k	20.55	c	14.40	i	13.27	j	280.5	j	Azara2	
20.15	g	19.95	d	14.25	i	17.30	f	322.5	g	Fengkang	
26.70	b	21.90	b	14.15	i	28.75	a	441.5	a	Trakia	
16.10	m	18.05	g	14.70	i	9.14	m	187.5	p	Pishtaz	
17.05	l	13.80	l	18.05	f	7.85	n	146	s	Siosson	
26.55	b	31.90	a	14.60	i	22.35	b	276	k	Alamout	
23.75	c	19.20	f	21.40	d	12.70	k	235	o	Bezostaia	
21.8	e	14.20	k	12.60	j	18.65	e	252	n	Garak79	
13.35	p	16.10	i	23.80	Bc	15.75	h	393	d	Konia2002	
12.35	o	10	m	17.75	f	13.70	i	290.5	i	Sabalan	Stress
20.85	f	4.335	o	14.45	i	16.85	g	419.5	b	Azara2	
13.20	o	18.05	g	16.10	g	21.20	c	411.5	c	Fengkang	
22.90	d	19.65	e	16.55	g	20.40	d	383	e	Trakia	
22.70	d	15.85	j	16.20	g	7.30	o	169	r	Pishtaz	
13.95	n	9.15	n	23.40	c	7.45	o	175.5	q	Siosson	
27.85	a	20.05	d	18.80	e	16.90	g	411.5	c	Alamout	
19.10	i	9.95	m	26.15	a	20.35	d	332	f	Bezostaia	
19.95	g	18.10	g	16.40	g	12.95	k	259.5	m	Garak79	
19.65	h	17.65	h	24.25	b	12.40	l	317.5	h	Konia2002	

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