Available online at www.scholarsresearchlibrary.com

Scholars Research Library

Annals of Biological Research, 2011, 2 (3) :352-358
(http://scholarsresearchlibrary.com/archive.html)

ISSN 0976-1233
CODEN (USA): ABRNBW

Bread wheat production under drought stress conditions

Keyvan Shamsi *. Soheil Kobraee

Department of Crop Production and Plant Breeding,Faculty of Agriculture.Kermanshah Branch.Islamic Azad University,Kermanshah ,Iran

---

ABSTRACT

Drought stress is one of the major abiotic stresses, which adversely affects crop growth and yield. drought is the main environment factor limiting wheat productivity Iran. An experiments was carried out in 2007-2008 on Mahidasht Agricultural Research Center in order to study the effects of drought stress on yield and some morphological traits of wheat cultivars under drought stress conditions. The experiments conducted to base on split plot in a randomized complete block design with three replications. Main plots included drought stress treatments at 4 levels: I_1- drought stress at the start of stem elongation stage trough the ripening stage with irrigating after 80% depletion of soil moisture ;I_2 -drought stress at the start of boot stage through the repining stage with irrigating after 80% depletion of soil misture;I_3- drought stress at the start of grain – filling stage trough the ripening with irrigating after 80%depletion of soil moisture; and I_4- full irrigation (irrigating during growth period after 40% depletion of soil moisture). And subplots included cultivars treatments at 3 levels: Chamran (C_1), Marvdasht(C_2), and Shahriar (C_3). A significant difference was observed between drought stress treatments so that the highest grain yield was obtained for control treatment (I_4)and the lowest for drought stress treatment (I_1).Compared to control treatment(I_4), treatments (I_1), (I_2), and (I_3) exhibited 81% , 53% , and 40% yield decreases ,respectively. Results showed that in comparison with other drought stress treatments, imposing drought stress at the start of stem elongation stage through the ripening stage (I1) had the most impact on reducing the yield of wheat cultivars. In different growth stages, different cultivars response to moisture stress and irrigation discontinuance differently. In response to moisture stress during different growth stages, Shahriar cv (C_3) was damaged more severely than Chamran cv (C_1) was, the latter enjoyed more yield stability under such conditions.

Keywords: Bread wheat, Drought stress, Yield stability, Morphological traits, Iran.

INTRODUCTION

A major limitation to yield and quality in many crop species is water availability throughout or at critical times in the growing season[7,9].limiting factors as low temperature in winter (absolute minimum of temperature;-30°C); high temperature during the terminal grain filling period (+35°C), and post anthesis water deficit condition in irrigated wheat, influence crop growth and yield [13].rought stress , entailed a significant decrease in grain yield, number of fertile spike per unit area, number of grain per spike , 1000 grain weight , biological yield, harvest index and plant height [10].

In a study on wheat, day &Intalop,[2]declared that decrease of grain yield relate to drought stress on stem elongation stage, It is result decrease number of spike per unit area and grain yield on spike.

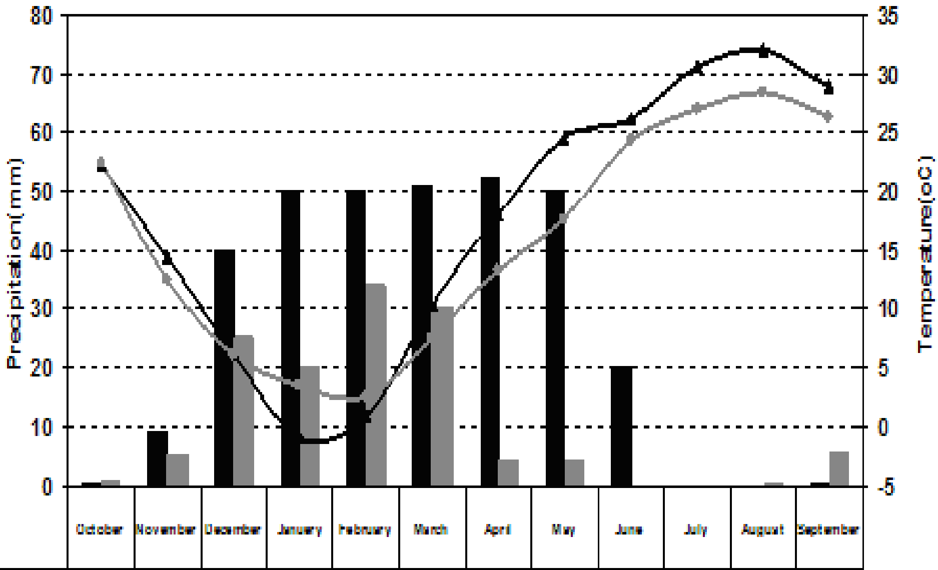
In a research , Entz & Fowler,[4]declared that environmental stresses between stages 21 (tillering) and 65 (flowering) had maximum effects on grain quantity, shoots dry matter production, harvest index, grain protein yield , number of spike per square meter, number of grain per spike , and number of grain per square meter.

Royo et al, [12] reported that flowering-to-maturing drought stress, especially accompanied by high temperature, shortened grain filling period for Triticale, reducing 1000 grain weight. Harvest index is so extremely affected by environmental changes that its value increases under desirable climatic conditions and decreases under drought stress condition at final period of plant growth [14].

Although the effects of plant height on yield have been studied under changes environmental conditions, a single result has not been reported yet [5].General objective of doing this experiment was to determine sensitivity of wheat growth stages to drought stress and determine, yield components and different traits related to yield under moisture stress conditions.

MATERIALS AND METHODS

This research was done, in 2007-2008 on Mahidasht Research Field of Agricultural Research Center (46°,50/ E ; 34°,16/ N), 1380 meter elevated from sea level. Based on dumarten's climate classification method, the area is parts of cold semiarid regions (Figure1). Mahidasht test site had loamy – clay texture with EC=1.4 ds.m^{-2} and PH=7.5.



	October	November	December	January	February	March	April	May	June	July	August	September
Precipitation(long time)	0.5	9.35	40.24	50.27	50.14	51.32	52.34	50.35	20.3	0	0	0.2
Precipitation(2007-08)	0.8	5.2	25.3	20.2	33.9	30.5	4.2	4.3	0	0	0.4	5.4
Temperature(2007-08)	22.2	14.5	6.3	-0.9	0.8	10.4	18	24.5	26.2	30.6	32	29
Temperature(long time)	22.41	12.45	6.11	3.56	2.53	7.5	13.24	17.75	24.42	27.08	28.42	26.3

Figure No.I:1Mean of temperature and precipitation in Mahidasht region, during the (2007-2008) farming year and long time (1976 – 2006).

Main plots included drought stress treatments at 4 levels: (I_1)– from onset of stem elongation stage thought the end of growth period; plots were irrigated after 80% depletion of soil moisture ; (I_2) – from onset of Boot stage ; plots were irrigated after 80% depletion of soil moisture ; (I_3) – from onset of grain- filling stage through the end of growth period; plots were irrigated after 80% depletion of soil moisture ; and (I_4), full irrigation (test plots were fully irrigated during growth period and after 40% depletion of soil moisture) , And subplots included cultivars at 3 levels: Chamran(C_1) , Marvdasht (C_2), and Shahriar (C_3). Each plot included 8 rows 20 cm apart, 4 meter long, 1 and 2 meter distances were taken between test plots and replicates, respectively.

Density was taken at 400 seeds per square meter. The first irrigation was carried out immediately after seeds were planted. Irrigation was carried out after 40% depletion of soil moisture for treatments (I_1), (I_2), and (I_3) from planting time to prior to stem elongation stage to prior to boot stage , and to prior to grain filling stage, respectively. At the end of growth period, plants from rows 4 and 5 of each plot, 3 meter long, were harvested from each plot center; and grain yield, was determined. Thousand grain weight was determined by selecting 10 random samples from grains harvested from each plot.

Number of grains per spike, plant height, and peduncle length, yield components and some morphological traits were determined by selecting 20 plants from each plot.

Analysis of variance of the data for each attribute was computed using the computer Program MSTAT-C[8].Mean values of each attribute were compared using the Duncan's multiple range test($p<0.05$).

RESULTS AND DISCUSSION

According to results of combined variance analysis, different experiment sites showed significant ($p=0.05$) and highly significant ($p=0.01$) differences for peduncle length, plant height, grain yield and for number of grains per spike, harvest index traits, respectively .

Giunta et al. studies, [6]showed that drought stress reduced all yield components so that numbers of fertile spike as well as number of grain per spike were decreased by 60% and 48% respectively.

Based on results obtained, drought stress had highly significant effects ($p=0.01$) on yield and all yield components so that control treatments(I_4) with yield equal to 6333 kg/ha^{-1} had the highest yield; and treatment (I_1) had the lowest yield, equal to 3377 kg/ha^{-1} , in comparison with control treatment(I_4). Day & Intalop,[2]reported that drought stress during stem elongation stage reduced the number of days from planting to flowering, plant height, grain yield, grain volumetric weight, number of spike per unit area, number of grain per spike and increased lodging with reduction of number of spike, grain yield also is decreased, therefore , yield depends on number of grain spike under such conditions, as a result, a significant correlation is observed between number of grain per spike and grain yield . Comparison of yield and yield components means shows that number of spike per unit area(701.3 spike) and number of grain per spike (16.9 grains) were reduced for treatment (I_1) .

Richards et al, [11]declared that during flowering stage, drought stress disrupted flowing photosynthesis and transfer of stored substances into grains, which can be cause of reduction of the number and weight of grains. Mean comparison table shows that Under stress condition (I_3) had no effects on number of spike per unit area because, in this treatment, drought stress was imposed after flowering and anthesis stages and reduced grains weight through shortening duration of reproductive period.

Day & Intalop, ,[2]reported that considerable decrease in grain yield for stress during stem elongation stage was because of reduction of number of spike per unit area and of grain yield per spike. Drought stress in stage (I_2), with yield equal to 4121 kg/ha^{-1} showed 53% yield reduction compared to control treatment (I_4).

Drought stress in stage (I_3) with yield equal to 4577 kg/ha^{-1} showed 40% reduction of yield compared to control treatment (I_4). Sieling et al,[15]reported that post flowering drought stress reduces number of spike and number of grain per spike, it can even reduce grain weight during final growth stages.

Raynolds et al, [10] and Donaldson, [3] reported that post anthesis drought stress reduced grain filling rate resulting in reduction of 1000 grain weight, which is in agreement with result of this experiment.

Table No.I: Effect of Cultivar and Irrigation on grain yield, yield components and some morphological traits.

Trait	PL(cm)	PH(cm)	SPSM	GPS	TKW(g)	GY($kg.h^{-1}$)	BY($kg.h^{-1}$)	HI(%)
				Irrigation				
I1	22.52C	55.44C	701.1B	16.09C	31.14B	3377D	10302C	30.82D
I2	27.42B	65.24B	702.3B	19.22B	31.29B	4121C	12040B	32.52C
I3	27.64B	79.56A	715.7A	21.42B	36.80A	4597B	11481B	39.80B
I4	32.33A	85.27A	710.6A	26.79A	37.47A	6333A	13395A	45.48A
				Cultivar				
C1	32.89A	83.52A	715.7A	21.73A	34.53A	4887A	12322A	38.75A
C2	26.80B	71.43B	713.4A	21.15A	35.06B	4795A	11954AB	37.89A
C3	25.37B	69.21B	702.3B	20.27B	32.57C	4400B	11204B	35.98B
				Irrigation×Cultivar				
I1C1	27.77BCDE	70.60 CDE	710.2BCD	18.01I	31.15 GH	3822 FG	11380BC	34.83F
I2C2	21.48 E	51.58 E	708.3CDE	17.05J	30.43H	3559 B	11002C	31.77 J
I3C3	21.88 DE	51.82 DE	701.4DE	16.22K	29.13I	3037 G	9034D	29.08 I
I2C1	29.71 BCD	75.21BCDE	710.7BCD	20.52G	32.54EFG	4312 CD	12681 ABC	35.31EF
I2C2	23.55 CDE	65.15 DE	702.2DE	19.35H	31.35 GH	4125 DEF	12007 ABC	33.54 FG
I3C3	22.53 DE	62.75 EF	695.2E	18.48IJ	30.22HI	3929 EF	11991 ABC	32.38GH
I3C1	32.72AB	85.27 AB	725.7AB	24.54C	35.51 D	4032 C	11504BC	41.30D
I3C2	27.18BCDE	80.99BCDE	711.8BE	23.15D	34.44 E	4291 CD	11540 BC	38.12 E
I3C3	25.89CDE	70.66 CDE	710.5BCD	23.19 E	31.89 F	4199 CDE	11420 BC	37.68 F
I4C1	37.14AB	98.69 A	703.1DEF	27.79 B	50.15 A	6415 A	13555 A	48.17 B
I4C2	31.15 ABC	87.01B	715.8 AB	29.14A	41.17 B	6581 A	13505 A	50.19 A
I4C3	28.99 BCDE	83.52 BC	704.2 DF	27.22 C	36.85 C	6012 B	13017 AB	46.53 C

Within treatment means followed by the same letter are not significatntly at $p<0.05$ according to Duncan,s multiple range test. PL: pedancle length PH: plant heigt: SPSM.; Spikes per square meter; GPS :grains perspike; TKW: thousand kernel weight:GY: grain yield; Biological yield ;HI: harvest index: I1,I2,I3 and I4:80% moisture depietion from grain filling period to end season ; 80% moisture depletion from flowering to end season ; 80% moisture depletion from stem elongation to end season and 40% moisture depletion , through growing season(control);C1,C2 and C3: Chamran, Marvdasht and Shahriar cultivars.

The results of variance analysis for gain yield and all yield components between experimental cultivars showed a significant difference so that Chamran cv(C_1) with yield equal to 4887 kg/ha^{-1} produced the highest yield rate and place along with Marvdasht cv (C_2)with yield equal to 4795 kg/ha^{-1} within a statistical group, but of Shahriar cv (C_3) with yield equal to 4390 kg/ha^{-1} showed a significant difference with Chamran (C_1)and Marvdasht cv (C_2). The higher was Chamran cv(C_1) related with number of grain per spike,1000 grain weight, number of spike per unit area, plant height and peduncle length , that this cultivar had height biological yield then to any cultivars.

The result showed that Chamran cv (C_1) had highest 1000 grain weight then to any cultivars harvest index had also a trend similar to that of 1000 grain weight, indicating inability of Shahriar cv (C_3) to transfer substances in to grain in comparison with Chamran (C_1) and Marvdasht cv (C_2). The number of grain per spike was higher in Chamran cv (C_1) that in Marvdasht (C_2) and in Shahriar cv (C_3). Caldrini et al, [1]believe that, recently, the increase in grain yield is largely grateful for the increase in grain number: this yield component is of more importance than 1000 grain weight.

In present experiment, results of variance analysis showed that cultivar and drought stress interaction effects on traits of harvest index, 1000 grain weight, number of grain per spike, and number of spike per unit area are significant . The highest and lowest 1000 grain weights related to Marvdasht cv (C_2) and control treatment(I_4),(6581 kg/h) and Shahriar cv (C_3) and treatment (I_1),(3037 kg/h) respectively.

Also, the highest and lowest number of grain per spike related to Marvdasht cultivar (C_2) and treatment (I_4),(29.14 grain per spike) and Shahriar cv (C_3) and treatment (I_1),(16.22 grain per spike) respectively. And the highest spike per unit area related to Chamran cv (C_1) and treatment (I_3),(725.7 spike) and after it, related with treatment (I_4) and Marvdasht cv (C_2), (715.8spike). Marvdasht cv (C_2) had the highest grain yield under full irrigation condition (I_4),(6581kg/h) and the lowest grain yield under stress treatment (I_1) related with Shahriar cv (C_3),(3037kg/h).

CONCLUSION

High yield of Chamran cv (C_1) is associated with number of grain per spike since this cultivar has retained superiority of its number of grain per spike in all drought stress treatments ., these results confirm that Chamran cv (C_1) is one of cultivars with high yield potential in moisture stress conditions on Mahydasht region.

Acknowledgement
This work was supported by grant from Research Council of Islamic Azad University Kermanshah Branch-Iran.

REFERENCES

[1]DF. Calderini, MP. Reynolds ,GA .Slafer, In: EH.Satorre,GA .Slafer, (eds) wheat: Ecology and physiology of yield determination. **(1999),** NewYork: food products press.
[2]AD .Day ,S.Intalop, *Agron.J.*,(**1970)**,62,27-29.
[3]E .Donaldson, *American Journal of Alternative agriculture*.,(1996),11 (2-3),89-94.
[4]MH .Entz,Fowler. DB, *Crop Sci*., **(1990)**, 30,1119-1123.
[5]RA.Fischer ,Maurrer.R, *Aust .J.Agric.Res***.,(1978),**29,897-912.
[6]F. Giunta Motzo.R, Deidda.M, *Field Crops Res***.,(1993),**33,339-499.
[7]JIL. Morison, Baker .NR,Mullineaux.PM,Davies.WJ, *Philosophical Transactions of the Royal Society of London*.,**(2008),** *Series B,Biological SCIENCES.*
[8]MSTAT Development Team, MSTAT user,s guide:A microcomputer program for the design management and analysis of agronomic research experiments**.,(1989),** Michigan State Univ.East Lansing, USA.
[9]MAJ.Parry,Flexas.J,Medrano.H, *The Annals of Applied Biology*.,**(2005),**147,211-226.
[10]MP .Reynolds, Skovmand .B,Trethwan. RM ,Singh.RP, Vanginkel. M.,Applying physiological strategies to wheat breeding. CIMMYT, Research highlights of the CIMMYT wheat program.**,(2000)**, Mexico ,DF 49-56.
[11]RA, Richards.Condon.AG, Rebetzke.GJ.,Traits to improve yield in dry environments., **(2001)** ,p.88-100. Mexico,DF,CIMMYT.
[12]C.Royo, Abaza .M,Blanco. R, Garcia del Moral. LF, *Aust .J. palnt physiol*.,**(2000),** 27,1051-1059.

[13]PA.Sanjari, Proceeding of the 10th Australian Agronomy Conference **.,(2001),**Hobart.
[14]KHM. Siddique, Whan. BR,*Euphytica* **.,(1994),**73,241-254.
[15]KO.Sieling, Christen H.Richter-Harder,Hanus .H,*J. Agron and Crop Sci.*, (**1994**), 173,2-40.

..