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Characterization of Some varieties of Durum Wheat (*Triticum durum Desf*) under Control and Water Stress Conditions.

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ABSTRACT

An experiment was implemented at INRAA research station located at Baraki, Algiers with the objective to characterize the behavior of seventeen genotypes of Durum wheat (Triticum Durum Desf) under water stress conditions. The experimental design adopted is that of split plot design with water regime (irrigated and non irrigated treatments) as main plots and varieties as sub plots and three repetitions. Leaf area, the relative water content (RWC%), chlorophyll content and tillers production were very significantly ($p<0.01$) decreased under water stress by, respectively, 52.64%, 30.19%, 10.22 % and 26.16%. However, except RWC (%) parameter which showed a significant difference between varieties ($p<0.05$), all other parameters showed no differences between varieties and theirs interactions with water regimes.

Keywords: Durum wheat (Triticum durum Desf.), water stress, Chlorophyll, morpho- physiological traits, irrigated.

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Introduction

In Mediterranean areas, especially in Algeria, durum wheat (*Triticum durum Desf.*) is an important crop. Wheat production in Algeria is not sufficient to meet the demand of a growing population. The average consummation is estimated at more than 190 Kg/years per person, where a total requirement is around 7.3 million tons for a population more than 38.7 million. The average production is estimated at 21 million quintals, resulting in coverage of imports of around 69%. The cost of these imports amounted to more than 1.5 billion dollars. This situation affects the economical situation of the country.

The primary constraint affecting this crop production is water scarcity. In Algeria, cereal production is concentrated in the semi-arid bioclimatic stage (350 and 500 mm), characterized by low and irregular rainfall. Moreover, climate change has resulted in the delay of rains, a deplacement of isohyets by about 100Km toward the north of the country, emphasizing at the same time the aridity. These characteristics imply adaptations at all levels (plant material, crop system, diseases). The water deficit occurs at different growth stages of wheat disturb the growth and development process.

This study aims to determine the effect of water stress on durum wheat **(***Triticum durum Desf.)* cultivars during the period from 6th leaf started to appear to the end of growth cycle, on leaf area, relative water content (RWC%), chlorophyll content and total tillers number.

Materials and methods

Field experiment

The experiment was carried out during the growing season of 2013-2014 at National Institute of Agronomic Research of Algeria (Long: 3°6'E, lat: 36°41'N, alt: 18m above sea level). Twelve cultivars selected from the international trials of CIMMYT (Mexico) and five varieties originated from Algeria were sown in pot culture (five seedling per pot) and in a greenhouse. Each pot contained 5Kg of mixture of organic matter, clay silt soil and sand (1:1:1). The characteristics of the varieties studied are presented in table 1.

The experimental design adopted, in this experiment, is that of a split plot design with two water regimes as main plot and 17 varieties as sub plots and three replications. The water stress treatment was imposed when the 6th leaf started to appear by stopping the irrigation, followed by a hydration period. The control plants were irrigated every two days.

From starting of water stress on 24.02.2014, many parameters were studied on each variety, each treatment and repetition: Leaf area (LA), Relative water content (RWC%), Chlorophyll content and Total tillers number (TTN).

Leaf area (LA): leaf area was measured by an automatic area meter, This measurement was achieved on a sample of three leaves completely deployed by variety and treatment. Values were estimated by cm2.

Relative water content (RWC%): the relative water content (RWC%) of the control and stressed plants is determined according to Barrs method's (1968):

$$\text{RWC (\%)} = \frac{FW-DW}{FWs-DW} x100$$

Where:

FW= Fresh weight

DW= Dry weight

FWs= Fresh weight at saturation

Chlorophyll content: chlorophyll content was, also, determined by using an device called SPAD.

Total tillers number (TTN): The total of tillers number was determined at the end of growth cycle.

Statistical analysis: The results were analyzed by using GenStat Discovery, version4, ANOVA two-way (in randomized blocks).

***Table 1*: List of the varieties studied**

N°	Varieties or lines	Pedigree	Origin
1	**LD357E/2*TC60//JO69/3/FGO/4/GTA/5/SRN_1/6/…**	CDSS04Y00755T-0TOPB-12Y-0M-06Y-1M-1Y-0B	Rép1-11
2	**SORA/2*PLATA_12/3/SORA/2*PLATA_12//SOMAT_3/4/AJAIA_13/…**	CDSS02B00849T-0TOPB-0Y-0M-7Y-2M-04Y-0B	Rép1-15
3	**CND/VEE//CELTA/3/PATA_2/6/ARAM_7//CREX/ALLA/5/ENTE/…**	CDSS02B00429S-0M-9Y-06Y-1M-1Y-0B	Rép1-21
4	**MINIMUS/COMB DUCK_2//CHAM_3/3/RCOL*2/4/…**	CDSS02B01108T-0TOPB-0Y-0M-5Y-4M-04Y-0B	Rép1-09
5	**Beni Mestina**	Témoin	Témoin
6	**MINIMUS_6/PLATA_16//IMMER/3/SOOTY_9/…**	CDSS02B00396S-0M-4Y-06Y-4M-1Y-0B	Rép1-03
7	**PLATA_7/ILBOR_1//SOMAT_3/3/CABECA_2/PATKA_4//ZHONG ZUO/.**	CDSS04Y00053S-13Y-0M-06Y-4M-1Y-0B	Rép1-16
8	**MINIMUS/COMB DUCK_2//CHAM_3/3/RCOL*2/4/SOMAT_4/INTER_8**	CDSS02B01108T-0TOPB-0Y-0M-5Y-4M-04Y-0B	Rép1-19
9	**BCRIS/BICUM//LLARETA INIA/3/DUKEM_12/2*RASCON_21/4/…**	CDSS04Y00362S-27Y-0M-06Y-4M-1Y-0B	Rép1-13
10	**Sigus**	Témoin	Témoin
11	**LDN7D(7A)/3*ASCONCHI/3/SORA/2*PLATA_2*PLATA_12//…**	CDSS04Y01137T-0TOPB-24Y-0M-06Y-1M-1Y-0B	Rép1-24
12	**ALTAR84/STINT//SILVER_45/3GUANAY/4GREEN_14//YAV_10/…**	CDSS04Y00341S-11Y-0M-06Y-3M-1Y-0B	Rép1-01
13	**TARRO_1/2*YUAN_1//AJAIA_13/YAZI/3/SOMAT_3/PHAX_1//…**	CDSS02B01143T-0TOPB-0Y-0M-7Y-4M-04Y-0B	Rép1-18
14	**LLARETA INIA/4/SKEST//HUI/TUB/3/SILVER/5/LHNKE/RASCON//…**	CDSS02B00574S-0M-12Y-06Y-2M-1Y-0B	Rép1-14
15	**Waha**	Témoin	Témoin
16	**Vitron**	Témoin	Témoin
17	**Korifla**	Témoin	Témoin

Results and discussion

Leaf Area (LA)

Leaf area ranged from 16.75cm2 for MINIMUS/COMB DUCK_2//CHAM_3/3/RCOL*2/4/…to 24.68cm2 for MINIMUS/COMB DUCK_2//CHAM_3/3/RCOL*2/4/SOMAT_4/INTER_8 and from 6.91cm2 for LDN7D(7A)/3*ASCONCHI/3/SORA/2*PLATA_2*PLATA_12//…to 12.41cm2 for TARRO_1/2*YUAN_1//AJAIA_13/YAZI/3/SOMAT_3/PHAX_1//…respectively, for watered and water stress conditions. Mean values of Leaf area was 24.68 cm2 and 9.31 cm2 respectively for watered and water stress conditions. Leaf area was significantly decreased under water stress by 52.64% ($p<0.01$) (Table 2). One adaptation form's to drought according to Arrandeau (1989). The other type of leaf adaptation developed by plants, against to water stress is the leaf enrolling. In wheat the leaf enrolling observed in some resistant varieties can be considered as turgor loss indicator and, also, a character of avoidance of dehydration (Amokrane *et al.,* 2002). The decrease of leaf area minimized water loss through transpiration, but it can cause a decrease of photosynthetic capacity (Bidinger and Witcombe , 1989).

***Table2*: Results of analysis of all parameters studied under irrigated and non-irrigated conditions.**

Parameters	TR	Min	Max	Mean	RR(%)	Fobs	CV (%)	LSD 5%
LA (cm2)	**IR**	16.75 (4)	24.68 (8)	24.68		127.08***	19.3	1.835
	NIR	6.91 (11)	12.41 (13)	9.31	**52.64**			
WRC (%)	**IR**	75.5 (9)	89.9 (10 and 16)	86.1		7.80**	56.9	6.94
	NIR	47.2 (15)	52 (10)	60.1	**30.19**			
Chl (Spad)	**IR**	45.57 (15)	55.27 (13)	50.77		53.79***	7.4	1.414
	NIR	43.6 (14)	47.62 (17)	45.58	**10.22**			
TTN	**IR**	3.022 (17)	4.86 (12)	3.86		65.93***	18.8	0.249
	NIR	2.4 (1)	3.33 (9)	2.85	**26.16**			

TR=Treatment, Min= Minimum, Max= Maximum, RR(%)=regression rate, Fobs.= Fisher Test, CV= variation coefficient, LSD: little significant difference, IR=irrigated, NIR= non irrigated, LA= leaf area, WRC=Relative water content, Chl=Chlorophyll content, TTN=Total tillers number, **very significant, *** very high significant.

(4), (8), (11), (13), (9), (10), (16), (15), (17), (12), (1), (14) = varieties

***Table 3*: Analysis of variance for parameters studied**

Parameters	Effect of Varieties		Effect of water		Interaction Var*Water	
	F	**Pr**	**F**	**Pr**	**F**	**Pr**
LA (cm2)	0.42	0.971	127.08	0.001	0.53	0.923
WRC (%)	1.91	0.035	7.80	0.007	1.60	0.053
Chlorophyll (Spad unit)	1.36	0.187	53.79	0.001	1.10	0.370
TTN	0.79	0.694	65.93	0.001	1.32	0.210

Relative water content (RWC%):

The results showed that variability within varieties and differences between treatments were significant ($p<0.05$) (table3). Under well watered conditions, RWC was highest. It ranged from 75.5% for

BCRIS/BICUM//LLARETA INIA/3/DUKEM_12/2*RASCON_21/4/…to 89.9% for varieties Sigus and Vitron and from 47.2% for Waha to 52% for Sigus respectively for watered and water stress conditions. RWC% mean values were 86.1% for watered conditions and 60.1% for water stress conditions. RWC%, which is often considered as an excellent indicator of plant water status, decreased significantly ($p<0.05$) by 30.19 % at the end of the water stress period.

Chlorophyll content

Regarding to the chlorophyll content, the results showed, also, that differences between treatments were very high significant ($p<0.001$). Chlorophyll content ranged from 45.57 spad unit for Waha to 55.27 Spad unit for TARRO_1/2*YUAN_1//AJAIA_13/YAZI/3/SOMAT_3/PHAX_1//…and from 43.6 spad unit for LLARETA INIA/4/SKEST//HUI/TUB/3/SILVER/5/LHNKE/RASCON//…to 47.62 spad unit for Korifla, respectively for watered and water stress conditions. Chlorophyll content mean values were 50.77 Spad unit for watered conditions and 45.58 Spad unit for water stress conditions, so chlorophyll content decreased under drought by 10.22%. These results can be explained by an enzymatic degradation of chlorophyll because of stomatal closure consequently to a low water availability.

Total tillers number

The total tillers number ranged from 3.022 for Korifla to 4.86 for ALTAR84/STINT//SILVER_45/3GUANAY/4GREEN_14//YAV_10/…and from 2.4 for LD357E/2*TC60//JO69/3/FGO/4/GTA/5/SRN_1/6/…to 3.33 for BCRIS/BICUM//LLARETA INIA/3/DUKEM_12/2*RASCON_21/4/… respectively for watered and water stress conditions. The total tillers numbers mean values was 3.86 for watered conditions and 2.85 for water stress conditions. A production tiller was significantly decreased under water stress 26.16%. Differences between treatments were very significant ($p <0.01$).

Conclusion

Water stress affected negatively all morphological and physiological parameters studied. Relative water content (RWC %) showed variability within varieties. This result can be related to the existence of osmotic regulation considered as very important under stress conditions. Regarding to the others parameters studied (leaf area, chlorophyll content and total number tillers number total), the behavior of varieties is the same.

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