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Variation in Early Growth, Canopy Temperature, Translocation and Yield of Four Durum Wheat (*Triticum durum* Desf.) Genotypes under Semi Arid Conditions

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ABSTRACT

The investigation was carried out on the experimental site of the Field Crop Institute Experimental Farm located near the town of Sétif (Algeria). The objective was to investigate the differences in developmental rate, canopy temperature and yield between four durum wheat (*Triticum durum* Desf.) genotypes. The experiment was laid down in a randomized complete block design with three replications. Data were collected on canopy temperature, relative growth rate, green flag leaf area duration, translocation, earliness, plant height and grain yield. The results indicated that the two genotypes, Waha and Boussalam, due to their fast early growth rate, accumulated significantly more above ground biomass at the juvenile, reproductive and grain filling growth phases. They achieved high dry weight of spikes m^{-2} at anthesis and at physiological maturity. Grain yield varied from 1.95 $t.ha^{-1}$ in MBB to 2.87 $t.ha^{-1}$ in Waha. The genotypes diverged also for the amount of assimilates transferred to the grain which varied from 26.6 to 39.5% of the final grain yield. These results indicated that the selection of faster early growing, short cycle genotypes, bearing smaller leaves and high spike number should be favoured for the high plateaus of eastern Algeria.

Keywords: *Triticum durum* Desf., Canopy temperature, Translocation, Early growth rate, Grain yield.

INTRODUCTION

The eastern high plateaus of Algeria have a continental Mediterranean climate with variable rainfall, ranging from 168.7 to 517.3 mm, 56 to 88% of which falls in the cold period, extending from October to March (Chenaffi *et al.,* 2006). Water remains the main factor limiting cereal crop production even though cold, late spring frost hazard and terminal heat are also frequent (Bouzerzour *et al.,* 1994; Annichiarico *et al.,* 2005; Mekhlouf *et al.,* 2006). Durum wheat is grown on the high plateaus, in a cereal- livestock farming system, in which straw and wheat residues are used as sheep fodder. Grain yield obtained is highly variable and low, compared to what is achieved in the neighboring countries (Annichiarico *et al.,* 2002; Bahlouli *et al.,* 2005). Under similar cropping conditions, plant breeders are looking for genotypes with a good yield potential associated with phenological and physiological features favoring stress tolerance (Blum and Pnuel, 1990; Annichiarico *et al.*, 2002; Fellah *et al*., 2002; Richards *et al.,* 2002; Mekhlouf *et al.,* 2006). Durum wheat yield improvements are possible if limitations are removed by introducing variability in the expression of specific traits enhancing stress tolerance and adaptability (Araus *et al.*, 1993). Increasing early growth vigour and total biomass production is desired under dry environments. The

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development of sufficient biomass, early in the season is important because soil moisture is available and can be utilized (Siddique *et al.,* 1991). Fast early growth insures a rapid ground cover, reduces soil surface evaporation and leads to the accumulation of a high biomass at anthesis (Copper *et al.,* 1987; Passioura, 2004). High biomass at this growth stage is a grain yield determinant, even when the grain filling period proceeds under stressed conditions (Regan *et al.,* 1992). High biomass at anthesis minimizes yield reduction under terminal heat and drought stress (Roseille and Hamblin, 1981; Simane *et al*., 1993; Fellah *et al*., 2002). Canopy temperature is an efficient method for a rapid monitoring of whole plant response to water stress. Canopy temperature variation provides clues for crop water status and yield performance under stress (Fischer *et al.,* 1998). Plant ability to remobilize stem reserves and photosynthesis activity of flag leaf, glumes and awns to support grain filling, are adaptive characteristics in high yielding genotypes under drought stress (Blum *et al.,* 1999). Yield improvement under stress conditions therefore must combine the high yield potential and specific factors, which are able to protect the crop against reductions due to different stresses. The objective of the present investigation was to compare growth patterns and yield formations under semi-arid conditions in a set of divergent genotypes of durum wheat (*Triticum durum* Desf).

MATERIALS AND METHODS

Experimental Details and Crop Husbandry

The experiment was sown, in mid November, at the field Crop Institute Experimental Farm, located 5 km south of Sétif town, on the eastern high plateaus of Algeria (1081 m asl., 5°21'E, 36°9'N) during the 2004/2005 cropping year. Four durum wheat genotypes (*Triticum turgidum* L. var. *durum*); namely Mohamed Ben Bachir (MBB), Waha, Boussalam and Adamillo/Duillio//Semito (ADS) were chosen on the ground of their suitable agronomic characteristics, mainly for the variation in plant height, staying green and earliness. MBB is a tall and late maturing commercial cultivar, selected from a local land race (Laumont and Erroux, 1961). Waha, whose pedigree is Plc/Ruff//Gta/Rtte, released also under the name of cham1, is an early heading, semi dwarf genotype, coldness sensitive, largely adopted by Algerian farmers (Mekhlouf *et al.,* 2006). Boussalam, with a pedigree Heider/Martes//Huevos de Oro, is taller than Waha and earlier than MBB. This advanced line was included in the study of Annichiarico *et al.* (2002) under the name of BD 1.94. Both Waha and Boussalam are selections of the CIMMYT/ICARDA durum wheat breeding program. ADS is a late and tall Italian advanced line characterized mainly by its staying green (Bahlouli *et al.,* 2005). These genotypes were laid down in a randomized complete block design with three replicates in plots of 6 m^2 (6 rows, 5m long and 0.20 m row spacing). Seeding rate was 250 viable seeds m^{-2}. Before sowing on black fallow as preceding crop, the trial was fertilized with 100 kg ha^{-1} of triple super phosphate (46% P_2O_5). 100 kg ha^{-1} of urea (35% N) were broadcasted at the onset of jointing (GS 31, Zadoks *et al.,* 1974). Weeds were controlled chemically with GranStar [*Methyl Triberunon*] at 12 g ha^{-1} rate.

Data Recorded

From the 2nd and 5th row of each plot, plants within a 0.3 m length were harvested at jointing, anthesis and physiological maturity, corresponding to the Zadoks growth scales GS 31, GS 60 and GS 90 (Zadoks *et al.,* 1974). The vegetative samples were separated into leaves, stems and heads, when appropriate, and weighed after being oven-dried at 80°C for 48 h, up to constant dry weight. The relative growth rate (RGR) was estimated as:

RGR (mg g^{-1} day^{-1}) = (1/BIO)(ΔBIO/ΔT)

where Δ_{BIO} (mg) is the dry matter accumulated between two consecutive dates, $\Delta_{T.}$

The net assimilation rate (A_{net}) was deduced from the formula:

A_{net} (mg day^{-1} m^{-2}) = (1/LA)(Δ_{BIO}/Δ_T).

The leaf area (LA) was estimated as:

LA (m^2) = 0.709 (L x l),

where L is the total leaf length, l is the average leaf width, and 0.709 is a coefficient relating the leaf area based on the product L x l to the leaf area measured with the area meter (Spagnoletti and Qualset, 1990).

The rate of flag leaf senescence (V, cm^2 day^{-1}) was assessed by regression of the green flag leaf area on the number of calendar days, from heading date to physiological maturity. The green flag leaf area duration (GFLAD) was estimated as the ratio of the green flag leaf area ($GFLA_H$, cm^2) measured at heading divided by the rate of flag leaf senescence:

GFLAD (days) = $GFLA_H$/V.

Canopy temperature (CT) was measured at heading (H), H+10 and H+20 days with an infra-red thermometer model Telatemp. Five readings were taken around 11.00 AM, averaged per plot, and their deviations from ambient air temperature were analyzed. Remobilization of pre-anthesis assimilates, contribution of pre-anthesis assimilates to grain yield and translocation efficiency were assessed according to the method and formulae reported by Papakosta and Gagianas (1991):

DMT (t ha^{-1}) = DMA – DMM + GY

DMT (%) = (DMT /GY) x 100

DMTE (%) = (DMT / DMA) x 100

where DMT, DMA, DMM, GY and DMTE are: dry matter remobilized, dry matter measured at anthesis, dry matter at maturity, grain yield and dry matter translocation efficiency, respectively. Plots were harvested mechanically at maturity, and grain yield was determined for each plot and adjusted to a 10% moisture level after oven drying 50 g grain samples to constant weight during 24 h at 80 °C. Plant height was taken, as the average of three measurements per plot, from the soil surface to the top of the spike without considering awns length. Thousand- kernel weight was estimated from the weight of 250 grains counted per plot.

Data Analysis

The statistical significance of differences between genotypes was determined by the analysis of variance. Relationships between variables were examined by regression analysis. All analyses were conducted using the software Irristat 5.0 release (2005).

RESULTS AND DISCUSSION

Dry Matter Accumulation, Growth Rate and Leaf Area

The amount of rainfall accumulated during the cropping season reached 357.0 mm, with 71.9% received in the autumn- winter period. The ambient air temperature rises sharply from March up to the end of the crop cycle, in June, hastening crop growth. May was unusually dry and hot (Figure 1). The analysis of variance of the accumulated above ground biomass, spikes dry weight, relative growth rate, leaf area and net assimilation rate indicated significant genotype, growth stage and interaction effects, suggesting inherent variation among genotypes in growth pattern (Table 1). Biomass yield varied from a low value of 0.69 t ha^{-1} measured in MBB at the jointing stage, to a high value of 9.52 t ha^{-1} measured in Waha at physiological maturity (Table 2).

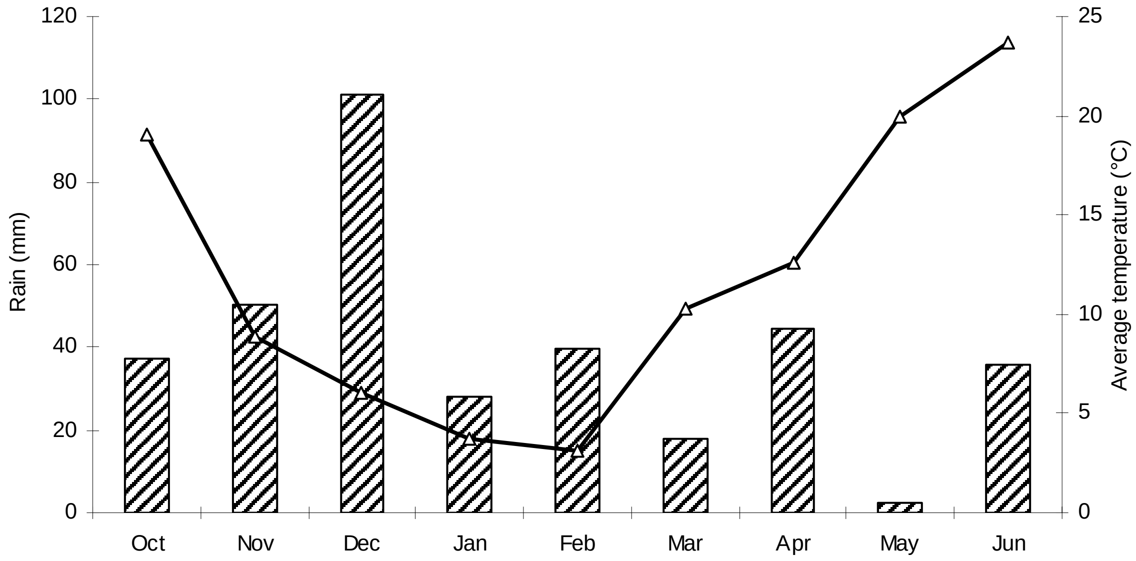

Figure (1): Accumulated monthly rainfall (dashed bars) and mean monthly temperature (line) measured during the course of the experiment.

Waha and Boussalam accumulated significantly more above ground biomass at the juvenile, reproductive and grain filling phases, compared to MBB and ADS (Table 2). They were characterized by significantly higher spikes dry weight, at anthesis and physiological maturity; while MBB and ADS presented low spikes dry weight at both growth stages (Table 2). According to Garcia del Moral *et al.* (2003), tillering and spikes per m^2 are favored by low temperatures and water availability; so early in the cycle, Waha and Boussalam diverted more dry matter to support growth of a high number of tiller- bearing spikes as compared to ADS and MBB (Tables 3 and 4). From emergence to jointing, the relative growth rate in Waha reached 1032.8 mg g^{-1} day^{-1} and varied from 513.4 to 732.0 mg g^{-1} day^{-1} in MBB, ADS and Boussalam. A sharp overall decrease in the RGR was observed in all genotypes, as plants grow older; even though the reduction was more severe in Waha than in Boussalam, MBB and ADS during the reproductive phase (Table 2), ADS, Waha and Boussalam developed a significantly larger leaf area per m^2 compared to MBB.

Table (1): Mean squares from the analysis of variance of spike dry weight (SDW, t ha^{-1}), above ground biomass (BIO, t ha^{-1}), relative growth rate (RGR, mg g^{-1} d^{-1}), leaf area (LA, m^2) and net assimilation rate (A_{net}, g d^{-1} m^{-2}).

Source of Variation	Traits							
	df	SDW	df	BIO	RGR	df	LA	A_{net}
Block	2	0.08	2	0.18	2565	2	0.06	0.03
G	3	0.69**	3	2.48**	53201**	3	1.84**	1.08**
GS	1	13.18**	2	205.5**	1678520**	-	-	-
G x GS	3	0.32**	6	0.45**	67113**	-	-	-
Error	14	0.017	22	0.08	972.0	6	0.11	0.10

ns, *, **: non-significant, significant effects at 0.05 and 0.01 of probability level; G =genotype, GS= growth stage.

Table (2): Spikes dry weight (SDW, t ha^{-1}), above ground biomass (BIO, t ha^{-1}), relative growth rate (RGR, mg g^{-1} d^{-1}), leaf area (LA, m^2) and net assimilation (A_{net}, g d^{-1} m^{-2}) measured during the juvenile, reproductive and grain filling growth phases in the 4 genotypes.

Growth stage	Genotype	SDW	BIO	RGR	LA	A_{net}
Jointing	Boussalam	na	0.92^{fg}	732.0^{b}	na	na
	Waha	na	1.26^{f}	1032.8^{a}	na	na
	MBB	na	0.69^{g}	513.4^{c}	na	na
	ADS	na	0.70^{g}	524.8^{c}	na	na
Anthesis	Boussalam	1.86^{d}	6.65^{d}	149.2^{d}	4.0^{a}	3.41^{b}
	Waha	1.72^{d}	7.27^{c}	110.9^{e}	3.5^{a}	3.99^{b}
	MBB	1.21^{f}	5.53^{e}	149.4^{d}	2.2^{c}	4.67^{a}
	ADS	1.58^{e}	5.85^{e}	160.5^{d}	3.4^{b}	3.30^{c}
Physiological maturity	Boussalam	3.40^{a}	9.27^{a}	10.3^{f}	na	na
	Waha	3.47^{a}	9.52^{a}	6.6^{f}	na	na
	MBB	2.97^{b}	9.21^{a}	9.2^{f}	na	na
	ADS	2.74^{c}	8.04^{b}	4.1^{f}	na	na
	$Lsd_{5\%}$	0.22	0.45	52.0	0.68	0.64

na =values not available; means within a column followed by the same letter are not significantly different at the 0.05 probability level.

The relatively high tillering capacity of Waha and Boussalam explained the high leaf area developed. As no information was taken about the number of leaves per stem, the leaf area developed by ADS could be explained by the leaf size as this is supported by the larger flag leaf area exhibited by this genotype (Table 4). MBB expressed a significantly high net assimilation rate, followed by Waha and Boussalam, ADS being the least one (Table 2). From jointing to anthesis, MBB accumulated efficiently more dry matter per unit leaf area, due to its low leaf area and tall stem. These results indicated that Waha and to a lesser extent Boussalam grow faster early in the season, accumulating significantly more above ground biomass when they reached the jointing growth stage. From jointing to anthesis, Waha, with a significantly reduced growth rate, achieved high above ground biomass yield and spikes' dry weight, followed by Boussalam. MBB and ADS with a relatively higher growth rate during this growth period, failed to reach the biomass yield exhibited by Waha. The results indicated that at maturity MBB reached similar biomass yield and spikes' dry weight as Waha and Boussalam, while ADS yielded significantly less.

The tested genotypes differed mainly in the growth pattern adopted in the juvenile and reproductive phases. Waha and Boussalam grow relatively faster from emergence to jointing; while MBB and ADS start growing rapidly after the jointing growth stage. The slow growth rate in MBB and ADS could be explained by the vernalization requirement and photoperiodic sensitivity. MBB and ADS behaved as semi-winter type varieties; while Waha and Boussalam behaved as spring-type varieties, with no vernalization requirement and moderate or no response to photoperiod. Both varieties exhibited a prostate growth habit associated with slow growth rate, early in the season. Waha and somewhat Boussalam are bearing the earliness characteristic to avoid terminal drought and heat stresses of the target mega environment represented by the West Asia and North Africa regions (Slafer *et al.,* 1999).

The results of this investigation showed that slow early growing genotypes, because of their vernalization and photoperiodic requirements, are not able to grow faster and to make the best use of the soil moisture available early in the season; while short cycle genotypes, such as Waha and Boussalam possess this ability because of their relative insensitivity to vernalization and to photoperiod. They developed a rapid leaf area early in the season, shading the soil surface, restricting water lost by evaporation, maximizing transpiration and improving the transpiration to evapotranspiration ratio. These results are in agreement with Siddique *et al.* (1991) who mentioned that high above ground biomass could be achieved through faster early growth. Slafer *et al.* (1999) suggested that the increase in aerial biomass could be achieved through a longer cycle (under favourable environments), higher photosynthesis activity per unit leaf area or faster early growth. Simane *et al.* (1993) and Villagas *et al.* (2001) explained that genotypes, with the ability to grow faster early in the season, are able to avoid terminal drought and heat stresses in Mediterranean environments.

Green Flag Leaf Area Duration, Canopy Temperature, Translocation and Yield

Waha developed a significantly small flag leaf area of 11.5 cm^2; while ADS had a larger flag leaf area of 16.5 cm^2 (Tables 3 and 4). Flag leaf of ADS senesced at a linear rate of – 0.5957cm^2 day^{-1}. The senescence rate of the other genotypes varied with time, having a quadratic form and taking values of - 0.0318t^2, - 0.0340t^2 and - 0.0326t^2 for MBB, Boussalam and Waha, respectively. Green flag leaf area duration varied significantly from 18.8 days in Waha to 27.7 days in ADS (Tables 3 and 4 and Figure 2).

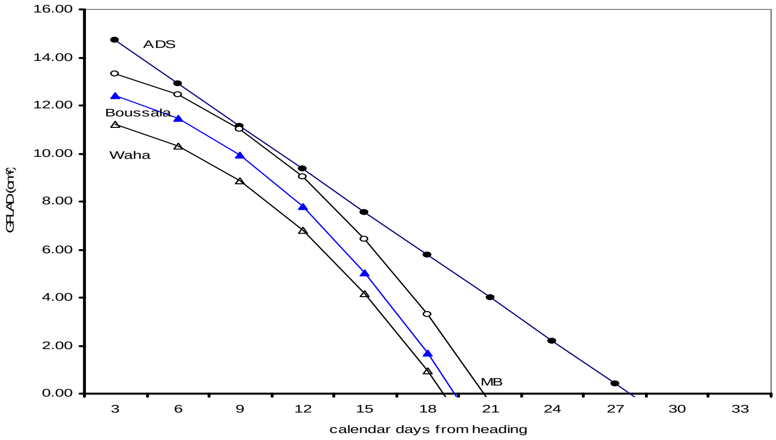

Figure (2): Pattern of the rate of the flag leaf senescence of the four evaluated genotypes.

Grain yield varied from 1.95 t ha^{-1} in MBB to 2.87 t ha^{-1} in Waha. Stem reserves remobilization was low in ADS with 0.646 t ha^{-1} and significantly high in Boussalam with 0.884 t ha^{-1}. This variation in the amount of the remobilized assimilates represented 26.2 to 39.6% of the final grain yield (Table 4). Boussalam with 11.5% was relatively more efficient in terms of translocation per unit of dry matter produced at anthesis (Table 4). Waha and Boussalam produced significantly more spikes per m^2 than MBB and ADS and had significantly shorter plant height. No significant differences were noted for 1000-kernel weight and crop canopy temperature among genotypes. Both Waha and Boussalam were early to head; while MBB and ADS were relatively late to head and taller (Tables 3 and 4).

Table (3): Mean squares from the analysis of variance of green flag leaf area(GFLA), green flag leaf area duration (GFLAD), grain yield (GY), dry matter translocation (DMT), dry matter translocation efficiency (DMTE), spikes' number (SN), 1000-kernel weight (TKW), plant height (HT), days to heading (DHE) and canopy temperature (CT).

Source of variation	Genotype	Block	Error
df	32	6	
GFLA (cm^2, H)	15.5^{**}	12.8	1.5
GFLAD (d)	46.6^{*}	0.44	9.36
GY (t ha^{-1})	0.43^{*}	0.02	0.05
DMT (t ha^{-1})	0.03^{**}	0.01	0.003
DMTE (%)	1.91^{*}	0.08	0.28
SN (m^2)	8130^{**}	361	247.4
TKW (g)	10.13^{ns}	1.00	3.23
HT	861^{**}	15.4	14.39
DHE	194.3^{**}	0.6	8.20

Source of variation	Genotype	Block	Error
CT (°C, H)	8.07ns	0.37	7.34
CT (°C, H+10d)	9.45ns	0.85	3.21
CT (°C, H+20d)	5.90^{ns}	2.97	2.88

ns, *, **: non-significant, significant effects at 0.05 and 0.01 of probability level; H = Heading stage; d= days.

Table (4): Green flag leaf area (GFLA), Green flag leaf area duration (GFLAD), grain yield (GY), translocation (DMT), translocation efficiency (DMTE), yield components (SN, TKW), plant height (PHT), number of days to heading (DHE) and canopy temperature (CT) of the four genotypes.

Genotypes	ADS	MBB	Boussalam	Waha	$Lsd_{5\%}$
GFLA (cm^2, H)	16.5^a	13.6^b	12.7^b	11.5^b	2.5
GFLAD (d)	27.7^a	20.7^b	19.3^b	18.8^b	6.1
GY ($t\ ha^{-1}$)	2.13^b	1.95^{bc}	2.52^{ab}	2.87^a	0.44
DMT ($t\ ha^{-1}$)	0.646^{bc}	0.772^b	0.884^a	0.753^b	0.109
DMT (%)	30.3	39.6	35.1	26.2	--
DMTE (%)	9.9^b	9.8^b	11.5^a	10.1^b	1.05
SN (m^2)	330.0^c	326.7^c	370.0^b	446.7^a	31.3
TWK (g)	44.7^a	44.7^a	43.3^a	46.4^a	3.6
PHT (cm)	74.3^a	96.0^b	62.0^c	55.4^c	7.5
DHE (d)	133.0^b	136.0^a	122.0^c	120.0^c	2.2
CT (°C, H)	28.7^a	28.3^a	27.8^a	29.3^a	4.7
CT (°C, H+10d)	31.3^a	28.7^a	28.9^a	30.5^a	3.6
CT (°C, H+20d)	31.3^a	30.0^a	31.5^a	31.6^a	3.4

H = Heading stage, SN = number of spikes m^{-2}, TKW= 1000- kernel weight, DHE= number of days from January 1st to heading, d= days; means within a row followed by the same letter are not significantly different at the 0.05 probability level.

The rapid change in the green flag leaf area, observed in the present study, was suggestive of strong effect of terminal drought and heat stress on post-anthesis photosynthesis activity. In fact, flag leaf blade, glumes and awns are the principal sources of photo-assimilates imported by the filling grain. Araus *et al.* (1993) mentioned that an increase in photosynthesis activity, under drought stress, is often observed in genotypes with smaller leaves, which are less sensitive to dehydration. Smaller leaves increase fitness in dry conditions as their decreased surface area to volume ratio inhibits desiccation. When drought is experienced at later developmental stages, selection should then favor genotypes harboring smaller leaves. Waha, Boussalam and MBB were characterized by a small flag leaf area, in comparison to ADS which exhibited a larger flag leaf area. Even though the differences among the tested genotypes in green flag leaf area duration and remobilized stem reserves were significant, they could not explain the observed grain yield differences. In fact, the analysis of the correlations among the measured traits showed that grain yield variation is explained essentially by the number of spikes produced per m², the number of days to heading and to a lesser extent by plant height. The former is positively correlated with grain yield and the two second traits had negative relationships with grain yield (Table 5).

Table (5): Correlation coefficients among the measured traits of the four genotypes.

	GFLA	GFLAD	GY	DMT	DMTE	SN	PHT	DHE
GFLA	1.000							
GFLAD	0.971*	1.000						
GY	-0.716^{ns}	-0.556^{ns}	1.000					
DMT	-0.673^{ns}	-0.795^{ns}	0.303^{ns}	1.000				
DMTE	-0.378^{ns}	-0.427^{ns}	0.395^{ns}	0.823^{ns}	1.000			
SN	-0.774^{ns}	-0.604^{ns}	0.962*	0.203^{ns}	0.171^{ns}	1.000		
PHT	0.442^{ns}	0.280^{ns}	-0.928^{+}	-0.207^{ns}	-0.508^{ns}	-0.807^{ns}	1.000	
DHE	0.723^{ns}	0.606^{ns}	-0.968*	-0.498^{ns}	-0.613^{ns}	-0.876^{ns}	0.932^{+}	1.000

ns, +, * = coefficient of correlation non-significant and significant at 0.10 and 0.05 probability level , respectively.

So Waha and Boussalam realized the best grain yield because of their ability to produce more spikes per m², associated with their early heading and short plant height. Wardlaw and Moncur (1995) reported that grain filling, in drought tolerant genotypes, relies on stem reserve remobilization in case where the last photosynthesizing organs senesce rapidly, so the dependence on stored assimilates for grain filling increased as the intensity of the post anthesis water and heat stresses increased. Even though the end of the crop cycle was characterized by reduced rainfall events and a sharp raise in air temperature (Figure 1), the results of this study failed to demonstrate any effect of the stem reserves' translocation on grain yield. However, the contribution of the stem reserves' translocation found in the present study was in the range reported in the literature. In fact, Giunta *et al.* (1995) reported a contribution of stem reserves' remobilization to the grain, varying from 10 to 70%, depending on genotype and environment. Bingham *et al.* (2007) reported that the contribution of stored stem reserves varied from 11 to 45% in barley, while Cruz- Aguado *et al.,* (1999) reported a range of 10 to 80% depending on the severity of the stress. However, the coefficient of correlation between grain yield and dry matter translocation was only 0.303^{ns}, which means that the measurement of dry matter translocation was not useful for grain yield prediction, at least, in the small set of the genotypes studied; where grain yield was more based on the number of spikes per m^{2}. Nevertheless, plant height and cycle length until heading appeared also as important traits affecting grain yield.

CONCLUSIONS

In the eastern high plateaus, the crop growth period is restricted, at the beginning of the season by lack of moisture, and at the end of season by water and high temperature stresses. Theses stresses leave little scope for lengthening the period of crop growth in order to increase dry matter production and yield. However, this can be achieved through increased growth rate early in the season when soil moisture is available and can be utilized. In the present, experiment, genotypes differed significantly for the leaf area developed, green leaf area duration, stem reserves' translocation, but variation among the tested genotypes in grain yield was strongly affected by the number of spikes produced per m², earliness and plant height. Waha and Boussalam exploited better the available resources early in the season; they matched a better phenology to the environment. This developmental advantage contributed to their avoidance of terminal heat and drought stress and to the expression of high grain yield. So, approaches to select the appropriate cultivar to the target environment, represented by the eastern high plateaus of Algeria, should be based on the synchronization of the crop phenology to match seasonal rainfall distribution pattern, early growth and avoidance of terminal heat and drought stresses. According to the results of the present study, the number of spikes per unit area and earliness could be useful selection criteria for grain yield improvement under semi-arid conditions.

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تباين النمو المبكر، وحرارة الغطاء النباتي، وتحويل السكريات المخزنة، والغلة الحبية لأربعة أنماط وراثية من القمح القاسي (*Triticum durum* Desf.) تحت الظروف شبه الجافة

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ملخــص

أجريت هذه الدراسة في الموقع التجريبي لمزرعة التجارب التابعة للمعهد التقني للمحاصيل الكبرى بالقرب من مدينة سطيف (الجزائر). تهدف التجربة إلى تحديد الاختلافات في سرعة النمو، وحرارة الغطاء النباتي، والغلة الحبية لأربعة أنماط وراثية من القمح القاسي (*Triticum durum* Desf.). صممت التجربة في قطع كاملة ذات توزيع عشوائي بثلاثة مكررات. شملت القياسات: حرارة الغطاء النباتي،سرعة النمو النسبي، شيخوخة الورقة العلم، نسبة تحويل السكريات المخزنة، تبكير الإسبال، طول النبات و الغلة الحبية. تظهر النتائج زيادة معنوية في تراكم الكتلة الحيوية للصنفين واحة وبوسلام، نتيجة سرعة النمو المبكر، وذلك أثناء المراحل الفتية والتكاثرية وتعمير الحبة. تظهر هاتان السلالتان وزناً مرتفعاً للسنابل/م^2 أثناء الإزهار و النضج الفيزيولوجي. تتغير الغلة الحبية من 1.95 طن لكل هكتار لمحمد بن بشير إلى 2.87 طن لكل هكتار لواحة. تختلف الأنماط الوراثية أيضا من حيث السكريات المخزنة المساهمة في تعمير الحبة والتي تتراوح من26.6% إلى 39.5% من الغلة الحبية. تشير هذه النتائج إلى أفضلية انتخاب أنماط سريعة النمو المبكر، مبكرة الإسبال، تنتج عدداً مرتفعاً من السنابل وذات أوراق صغيرة الأبعاد، للهضاب العليا الشرقية الجزائرية.

الكلمات الدالة: *Triticum durum* Desf.، حرارة الغطاء النباتي، تحويل السكريات المخزنة، سرعة النمو المبكر، الغلة الحبية.

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