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Performance of Ten Durum Wheat (*Triticum durum* Desf.) Cultivars under Semi Arid Conditions (North Africa-Algeria)

[1]*Bouchareb,* [1]*Radia, Gherroucha,* [2]*Houcine and Guendouz,* [3]*Ali, Moumeni,*
[4]*Lyes Hazmoune,* [5]*Tahar Zoghmar Meriem and* [6]*Zeltini Abdesselam*

[1]Vegetal Biology and Ecology Departement,
Sciences Faculty of Nature and life, University 1 / Constantine, Algeria
[2]National Institute of Agricultural Research of Algeria (INRAA), Setif Agricultural Research Unit

Abstract: This study was conducted during the 2013/2014 agricultural season at ITGC station of Constantine; the objective of this work is to study the effect of water stress on the growth, physiological and chemical parameters of leaves and grain in ten varieties of durum wheat imported and improved local and also knowing the diversity of the response & the biggest pay off among these varieties. The obtained results revealed proven in several studies have shown that the response of durum wheat to water stress associated with cultivar, intensity of water stress and it's duration. The study showed that varieties have responded to water stress with different mechanisms in varying proportions between the imported and improved local to maintain the vital functions of durum wheat.

Key words: Water stress · Durum wheat · Physiological · Biochemical · Morphological · Yield

INTRODUCTION

Especially over the last 100 years, our unbridled exploitation of the world's natural resources has severely damaged its vegetation and has also resulted in worrying accumulations of industrial wastes and green house gases. Together, these have upset natural ecosystem balances and have created many environment and climatic problems, including rising temperatures, increasing desertification, serious soil loss, soil salinization and damaging accumulations of soil nitrogen [1]. In many nations, the recent increased incidences of severe drought and associated desertification are coming into especially sharp focus because of their sudden, long term and devastating consequences for the local human population.

Drought imposes one of the commonest and most significant constraints to agricultural production, seriously affecting crop growth, gene expression, distribution, yield and quality [2]. There are numerous reports on photosynthetic and metabolites characteristics underwater stress [3] Generally, photosynthesis is inhibited by water stress, also affects photosynthetic components and chloroplast stress [4] Plants have evolved a number of mechanisms to adapt and survive water stress. Some plant species have evolved mechanisms to cope with the stress, including drought avoidance, dehydration avoidance, or dehydration tolerance. Such adaptive mechanisms are the results of a multitude of morpho anatomical, physiological, biochemical and molecular changes [5] But to our knowledge, only a few report about the effects of different level of water stress on photosynthetic and metabolites of wheat seedlings improved.

MATERIALS AND METHODS

Field experiment was conducted during the 2013-2014 cropping seasons at the experimental field of Constantine ITGC, Algeria. The statistical design employed was split plot based on a complete randomized block design (CRBD) with four replications each. Ten durum wheat cultivars *viz.,* Vitron, GtaDur, Sigus, Wahbi, Otb4, Arthur, Bousselem, Cirta, Bidi17 and Waha were used in this study. The seeds were sown using an experimental drill in 1.2 x 2.5 m plots consisting of 6 rows with a 20 cm row

Corresponding Authors: Bouchareb, Vegetal Biology and Ecology Departement, Sciences Faculty of Nature and life, University 1 / Constantine, Algeria.

space and the seeding rates for both experiments were about 300 seeds per m^2. Weeding and hoeing were carried out manually to keep the crop free from weeds throughout the growth period. At maturity data on 3 plants of each variety per treatment were selected at random, tagged and labeled properly to record plant height, leaf area, proline and proteins.

Proline Determination: The proline is extracted in methanol at 85°C from 100mg of fresh leaves, the assay is performed according to the method of Troll and Lindsay [6], modified by Monneveux and Nemmar [7]. The amount of proline is determined by spectrophotometry at wave length 528 nm. Each assay was performed with three replicates per genotype;the results are expressed as µmol /mg of dry-matter (DM).

Leaf Area (LA) Measurements: LI-COR LI-3000C Portable Area Meter was used to measure the leaf area.

Protein Determination: Using the method of Johnson and Ulrich / 1959 which is based on the digestion process: the metal interaction chromatography, also according to protein content in grain by multiplying the percentage of nitrogen sample in the laboratory 5.7.

Statistical Analysis: Statistical analysis was carried out with the Xlstat Version (2014) computer software. Data was subjected to analysis of variance (ANOVA) and means were compared using least significant differences according to procedure followed.

RESULTS AND DISCUSSION

Plants were found to have capability to adjust to environmental conditions, which is usually unstable due to various environmental factors. Water stress has the drastic effect on the plant height of all the wheat varieties used in the experiment. The wheat varieties used in this experiment showed significant differences ($p<0.05$) between them at increasing level of water stress for plant height, leaf area, proline and proteins (Table 1).

Proline Concentration: There were significant differences ($p<0.05$) between genotypes for this osmolyte. Fig. 1 shows that all genotypes react positively with accumulating proline under stressed conditions.

Under stressed condition, Gta dur registered the highest values (5.77µmol/mg DM) but the lowest values were recorded in Bidi17 (2.44 µmol/mg DM). High proline content in wheat and other plants after water stress has been reported by [8], [9] and [10] Under stress condition, proline is synthesized from glutamate due to loss of feedback regulation in the proline biosynthetic pathway [11] Rapid catabolism of proline upon relief of stress may provide reducing equivalents that support mitochondrial oxidative phosphorylation and the generation of ATP for recovery from stress and repair of stress induced damage [12]. The relationship between proline accumulation and environmental stress suggests that proline could have some protective function. [13] demonstrated that a number of solutes, including proline, protected enzymes, isolated from various tissues, from inactivation by heat.

Table 1: Compared means under stressed conditions

Génotypes	Proteine	Proline	Leaf area	Plant High
Vitron	3.39	3.52	19.17	62,16
Gta dur	4.62	5.77	23.28	55,66
Waha	4.35	2.99	32	64,6
Cirta	3.39	4.41	19.52	79,16
Bidi 17	5.24	2.44	19.03	83,5
Wahbi	5.08	3.25	27.85	59
OTB4	4.47	3.80	48.18	51
Sigus	5.39	3.93	32.35	47,16
Arthur	3.03	5.02	34.17	55,83
Bousselem	4.85	2.45	28.57	61.66
max	5.24	5.77	48.18	51
min	3.03	2.44	19.03	47,16
Conditions Effect	NS	**	***	***

Leaf Area (LA): According to Table 1, under stressed conditions, Otb4 registered the highest value (48.18, cm^2); the lowest values were recorded in Bidi17 (19.03cm). There were significant differences ($p<0.05$) between genotypes. The work of [14] revealed that the water stress significantly reduced leaf area due to the reduced cell division. Periodic measurements during the crop growth cycle also allow the estimation of leaf area development as an indicator of stress [15] The difference in leaf area related to plant size and water demand is an important factor when comparing plant responses to stress experiments where water is the limiting factor. Larger plants use more water than smaller ones and therefore, a large plant may show symptoms of stress before a smaller one when grown at limited water content [16].

Plant Height: The effect of different water stress levels was clear on all the traits of wheat varieties. Almost all the varieties had produced good plant height parameters were significantly reduced at highest drought, the terminal drought. The plant height of variety Sigus was most significantly affected at higher water stress level while

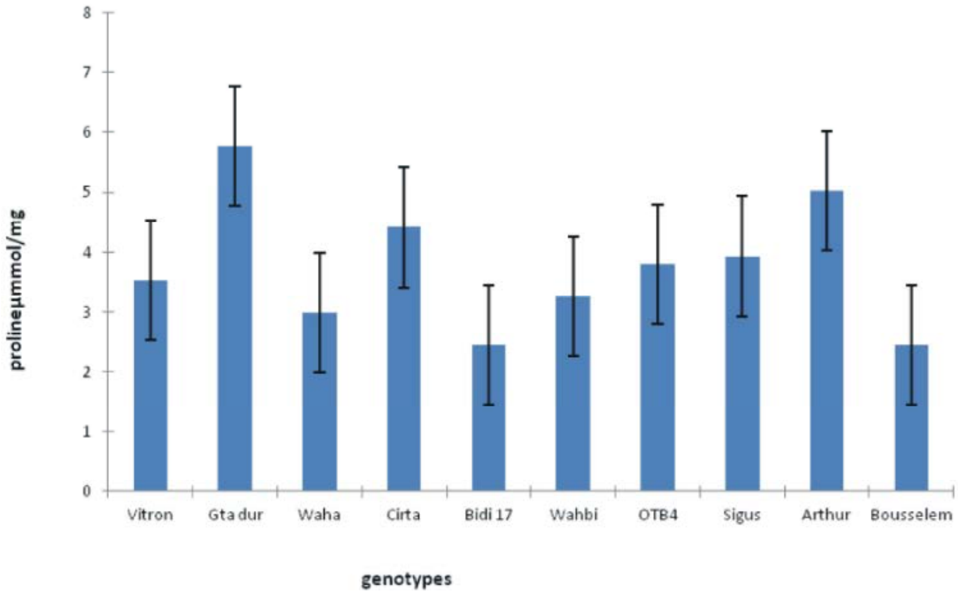

Fig. 1: Proline amount of the ten genotypes under stressed conditions

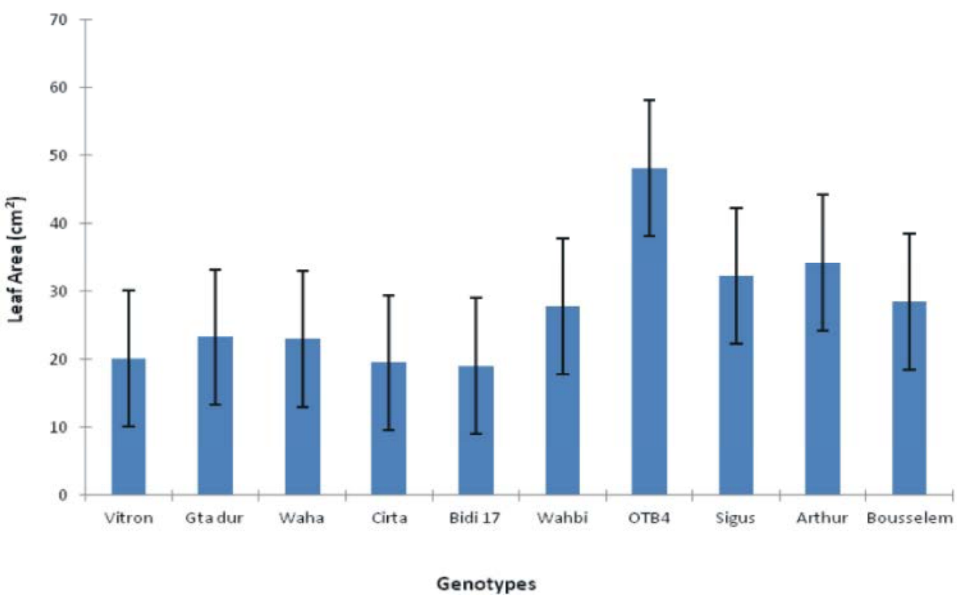

Fig. 2: Leaf area of the ten genotypes under stressed conditions

variety Bidi17 produced taller plants in response to all stress levels than other varieties. Plant height plays an important role in photosynthesis. [17] and [18] have reported that shoot length of guar genotypes significantly reduced under water stress. Similarly [19] and [20], [21] also observed that plant height in wheat varieties and maize/sorghum cultivars reduced significantly under water stress conditions.

Protein: Under stressed condition, Sigus registered the highest values (5.39%) but the lowest values were noted in Arthur (3.03) reduced N mineralization and available N. A major consequence of reduced mineralization was less soil available NO_3 for plant growth. These findings suggest that conceptual model where N and water are simultaneously taken up by the plant, as proposed by [22] in corn (*Zea mays* L.), is operational in wheat and that climate, soil and management interact to influence wheat production, protein composition and dough quality and that by understanding these relationships it may be possible to improve food security.

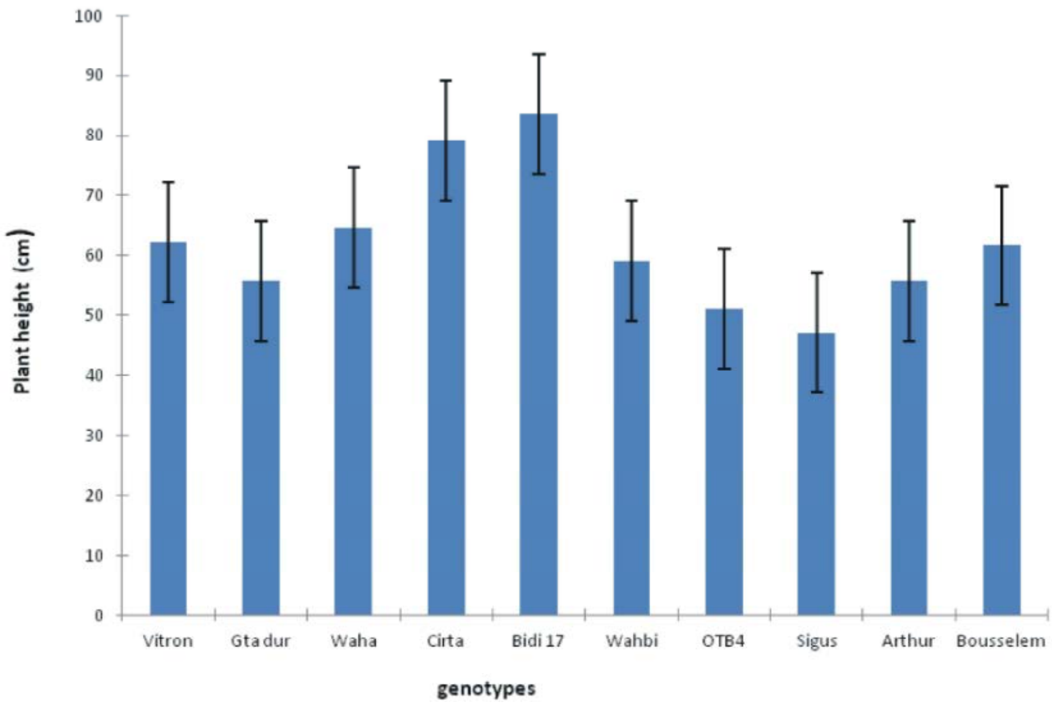

Fig. 3: Plant height of the ten genotypes under stressed conditions

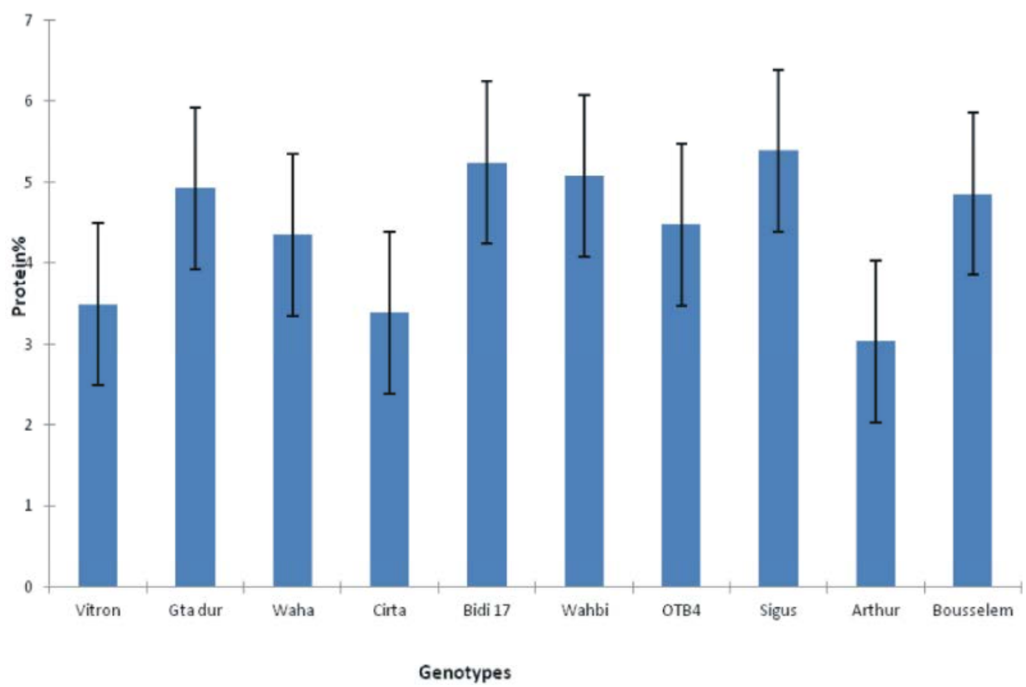

Fig. 4: Protein amount of the ten genotypes under stressed conditions

CONCLUSIONS

Physiological traits of wheat differed in their responses to deficit irrigation. However, irrigation deficit reduced plant height, leaf area, proline content and protein content. The wheat performance under deficit irrigation conditions was associated with a great ability of osmoregulation such as: proline-soluble proteins. The results of this study suggest that some osmoregulators is preferable in wheat if water supply is limiting.

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