



## Tolerance to salt stress applied on two local varieties of durum wheat, Benbachir and Sémito

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### Abstract

In arid and semi-arid areas, especially around the Mediterranean regions, soil salinity is a major abiotic factor that reduce agricultural yields in several crops. The wheat is facing this problem in Algeria. This study aims to compare the behavior of two local varieties of durum wheat under different concentration of NaCl: 0; 25; 50; 75; 100 mM. The results obtained show that the response to salt stress applied to both varieties "Benbachir" and "Sémito" is different in metabolic point of view, The synthesis of chlorophyll in the Benbachir variety results in a very highly significant difference ( $p \leq 1 \%$ ) of the 25 mM dose compared to the control for chl(a). For Sémito variety, the synthesis of chlorophyll present a no-significant difference for chl(a) and carotenoids. For Benbachir variety, difference equal averages treated by doses of 25 and 75 mM total protein is very highly significant ( $p \leq 1 \%$ ). in the variety Sémito the difference in mean total protein is not significant.

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## Introduction

Grains are considered as a major source of human and animal nutrition (Slama *et al.*, 2005). They occupy a globally primordial Place in the agricultural system. Among these cereals, wheat ranks first in world production and second after rice as a source of food for human populations, it provides 15% of its energy needs (Bajji, 1999). The processes involved in the development of a crop's yield are influenced not only by genetic factors but also in response to environmental factors (Monneveux, 1997). Growth and productivity of cereals are significantly affected by biotic stresses such as pests, viruses and fungi, and abiotic stresses such as water stress, salt stress, cold, oxidative stress and ultra violet (Tester, 2005). Among them, soil and irrigation water salinity which is a limiting factor in plant productivity and crop yield in the arid and semi-arid (Zid, 1991, Baatour and al., 2004). These ecosystems are characterized by low and strong erratic rainfall associated with a significant evaporation that promotes the accumulation of salts in the soil (Mnif, 2004, Rezgui *et al.*, 2004, Hayek, 2004, Munns *et al.*, 2005). This phenomena affects nearly 7 % of the total area in the world (Munns, 2002). Algeria is among the affected countries, nearly 3.2 million hectares of the area are saline (Hamdy, 1999; Belkhdja, 2004). The impact of salt on the development and yield of plants are numerous. In several plant species, the damage caused by salt stress commonly occurs by a sequence of morphological and physiological changes (Levigneron *et al.*, 1995).

The high salt concentrations can affect different stages of plant development (Patridge And Wilson 1987, Thamir, 1992). They cause an ionic imbalance and toxicity in plants, which can affect some vital metabolic processes. Plants have a considerable genetic potential for tolerance of environmental stress. In particular, the yield of cultivated present different degrees of sensitivity to salt and water stress plants, which is why we focus on this variability for stress tolerance which enables us to consider the choice of species in relation to environmental

conditions. In this context, our choice was focused on two local varieties of durum wheat: "Benbachir" and "Sémito".

The objective of this work is to study the effect of different concentrations of NaCl on the variation of biochemical metabolism in two durum wheat genotypes at an early stage of its development.

## Material and methods

### Plant material

The experiment is conducted on grains of durum wheat (*Triticum durum Desf.*). These two durum wheat genotypes . Semito and Ben Bachir provided by IAOC (interprofessional Algerian Grain Board ) of the Wilaya of Annaba. Grains of each variety were disinfected with bleach to 1% for a few minutes and rinsed with distilled water to remove all traces of chlorine water. After 24 hours of soaking in distilled water, the studied seeds are put in germination in petri dishes on sterile Gases an account of 10 seeds per dish , soaked in 10 ml of distilled water for 10 days . Wheat is transplanted into plastic pots filled with the following mixture : 2V/V/V ( 2 volumes of silica sand previously washed several times with 1 volume of distilled water soils , lined with 1 volume of gravel to insure the drainage ), each jar contains 1kg of dry land. Each pot contains six seedlings. Watering seedlings is done with distilled water for the first week, then the nutrient solution of Murashige and Skoog (1962) for two weeks ( 3-4 leaf stage ) every third day until field capacity .Starting from the 4th week of seedlings in pots , the application of saline treatment begins. Watering is thus performed with the nutrient solution supplemented or not with different doses of NaCl : 25, 50 , 75, 100 mM. harvest was done after 15 days of treatment .

### Analytical methods

Analyses have involved the determination of chlorophyll (Chl a, Chl b, and a + b chl carotenoids) according to the method of Lichtenthaler (1987), the total protein by the method of Bradford (1976) and soluble sugars using the anthrone method according

to Shields (1960). The obtained results were analyzed within each variety by Dunnett test and the comparison of the effectiveness of doses between varieties was performed by Student's T test.

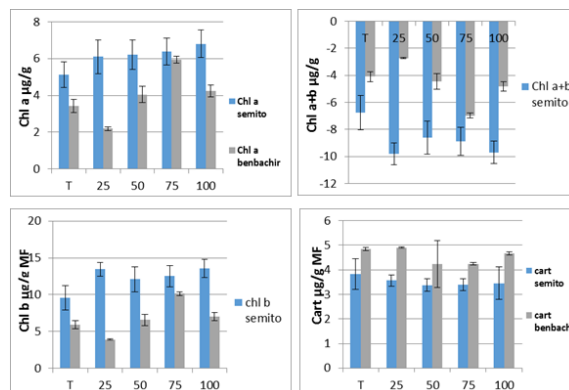
**Results and discussion**

*Effect of salt stress on the biochemical metabolism inside of each variety*

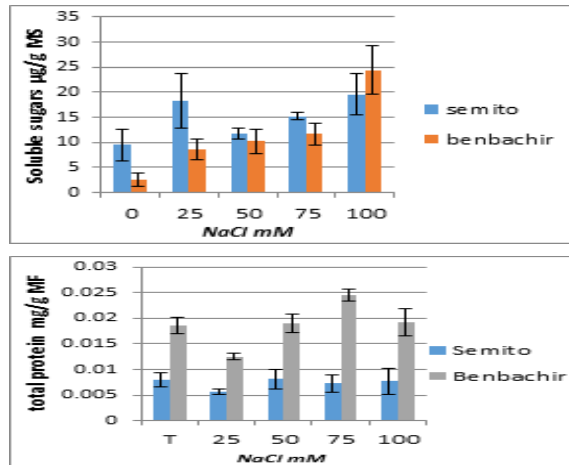
The obtained results of chlorophyll of both Semito and Benbachir varieties are presented in Figure 1. The effect of salt stress on the synthesis of chlorophyll in Benbachir's variety results in a very highly significant difference ( $p \leq 1\%$ ) of the 25 mM dose compared to the telltale for the chl (a). It is also to Chl (b) and chl (a + b) but for the 50 and 75 mM concentrations. However, no significant difference was reported for carotenoids. The synthesis of chlorophyll a, b and a + b, respectively at these doses increased processing 4µg/MF, 6.6 to 7.7 mcg / MF and from -4.8 to -4.5. Metabolic changes in chlorophyll for this variety are influenced 70% by saline treatment. For the effect of variety Semito salt stress applied to the synthesis of chlorophyll has a non-significant difference for chl (a) and the carotenoids. However, the average difference is significant for respectively chl (b) and chl (a + b) ( $p = 0.038$ ) ( $p = 0.025$ ) compared to the telltale. The chlorophyll synthesis is disturbed partially by the salt treatment. The results obtained are in perfect agreement with those of Wang (2000). The results of the determination of the total protein and soluble sugars are presented respectively in Figures 2 and 3. For Benbachir variety, difference equal medium treated by doses of 25 and 75 mM total proteins is very highly significant ( $p \leq 1\%$ ). However, in the variety Sémito the difference in mean total protein is not significant. These results show that salt stress is applied with no effect on protein synthesis in the Semito variety unlike in the Benbachir variety.

Regarding the metabolism of soluble sugars, the results obtained for the variety Benbachir increase very highly significantly ( $p \leq 1\%$ ) from 25 mM concentration. Among the variety Semito the

difference in mean concentrations was significant ( $p = 0.022$ ) for treatments 25 and 50 mM. The accumulation observed in the Benbachir variety sugars is probably due to the direct effect of salt on the storage of sugars. Our results are comparable with those found in Ben Khaled and al (2003). In addition, studies have shown that the accumulation of soluble sugars citrus leaves could be an indication of salinity tolerance.



**Fig. 1.** Effects of salt stress on the synthesis of chlorophyll (a), (b), (a + b) and carotenoids after 15 days of treatment.



**Fig. 2 and 3.** Effect of salt stress on the determination of soluble sugars and total protein synthesis.

*Comparison of effect of salt stress on both varieties*

Comparison of biochemical parameters studied between the two varieties are used to define the similarities between the varieties. Regarding the synthesis of chl (a) and Semito Benbachir chezles varieties, difference means are equal controls is very significant ( $p = 0.020$ ). The effect dose of 25mM and

100mM synthesis Chl ( a ) shows two varieties of a very significant difference (  $p = 0.002$  ) (  $p = 0.006$  ) in average , while the effect of the dose is significantly 50mM (  $p = 0.014$  ). However, the dose is 75 mM without any effect on the metabolism of chl ( a ) in both varieties. For the synthesis of Chl ( b ) , the difference in equality of means of control is significant (  $p = 0.023$  ) . The effect of the tested doses respectively is very highly significant (  $p \leq 1\%$  ) to 100 mM and 25 mM, very significant (  $p = 0.07$  ) and 50 mM for significant (  $p = 0.05$  ) to 75 mM. For the synthesis of Chl ( a + b ), the difference in equality of means of control is significant (  $p = 0.025$  ). The impact of dose on 25 mM and 100 mM, the synthesis of chl ( a + b ) in both varieties is very highly significant (  $p \leq 1\%$  ), while the impact of 75 mM dose remained significant (  $p = 0.034$  ). Moreover, the comparison of the average of the two witnesses of carotenoids was significant (  $p = 0.033$  ) in both varieties. The effect of the doses 25 mM 75 mM and 100 mM and doses on the synthesis of carotenoids is respectively very highly significant (  $p \leq 1\%$  ) and significant (  $p = 0.10$  ) (  $p = 0.012$  ) . However, the effect of 50 mM dose on the metabolism of lipid pigments in varieties Benbachir Sémito and is not significant. As regards the comparison of total protein metabolism between the two varieties, unlike equality of means of control doses: 25 mM, 75 mM is very highly significant (  $p \leq 1\%$  ). For doses: 50 mM and 100 mM, the difference is significant. However, the comparison of the metabolism of soluble sugars, shows a difference of equality of means significant (  $p = 0.024$  ) (  $p = 0.046$  ) respectively for the control and 25 mM dose. The 50 mM, 75 mM and 100 mM doses show a nonsignificant difference. From these results, the comparison of the effects of salt stress applied on Benbachir Sémito varieties and shows that the synthesis of soluble sugars is probably not directly related to the salt concentration of the environment unlike protein synthesis.

### Conclusion

The response to saline stress applied on the two varieties Benbachir and Semito is different in

metabolically. Among the variety Benbachir, metabolic changes affect chl chlorophyll ( a ), chl ( b ) and chl ( a + b ). However, carotenoids remain in this range without any modification made their lipoidal in nature. Among the variety Semito, have chl ( a ) and the carotenoids which are not altered by saline stress unlike chl ( b ) and chl ( a + b ). Additionally, in this range the effect of stress salt on protein synthesis is without effect with respect to the variety Benbachir where total protein concentrations rise very highly significant. Among the variety Benbachir, the accumulation of soluble sugars is probably due to the effect of salt that stimulates carbohydrate anabolism. Furthermore, comparison of the effects of salt stress between the two varieties identifies some similarities in doses tested in this experiment. The 75 mM dose is without effect on the synthesis of chl ( a ), the 50 mM dose and no effect on the synthesis of carotenoids and finally 50 mM, 75 mM and 100 mM doses no effect on the synthesis of soluble sugars.

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