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SEAWEED EXTRACT TREATMENT ENHANCES VEGETATIVE GROWTH AND ANTIOXIDANT PARAMETERS IN SALT STRESSED *TRITICUM DURUM* L.

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***Abstract**: Nowadays, food security depends on the increased production of cereals such as wheat (Triticum durum L.) which is one of the main sources of calories and protein. However, crop production is severely affected by adverse environmental stresses such as salt stress (Rahaie and al., 2013). To limit the negative effet of salinity on plant growth, many methods have been used. A lot of research studies have shown the importance of liquid extracts obtained from seaweeds as foliar sprays for several crops to improve growth under adverse factors (Metha and al., 1967, Latique and al., 2014). The present study reports the result of wheat plants (Triticum durum L.) irrigated with either 2 or 4 g/l of saline solution (SS) by sodium chloride (NaCl) were treated with aqueous extracts of green macroalgae Ulva rigida (URE) in order to increase wheat salt tolerance. Seaweed treated plants showed higher ability to tolerate salt stress (2 or 4 g/l of NaCl) by significant (P>0.5%) increasing of photosynthetic pigments (Chlorophyll: Chlorophyll total, chlorophyll a and b types) contents. The increase of these contents was associated with increasing activities of antioxidant enzyme systems superoxide dismutase (SOD); phosphoenolpyruvate carboxylase (PEPC); glutathione reductase (GR); Glutamate dehydrogenase (GDH); glutathione peroxidase (GPx); glutathione-S-transferase (GST); Isocitrate dehydrogenase (ICDH). However, wheat plant exposed to salt stress showed significant changes in all growth parameter and antioxidant enzyme activities compared with that in plants irrigated with regular water. This study indicates that the algae extracts could be used as a promising plant growth enhancer for treating wheat plants irrigated with saline solution.*

***Keywords:** Antioxidant enzyme, food security, wheat plant, salt stress, seaweed extract, Ulva rigida*

INTRODUCTION

World agriculture is facing a lot of challenges like producing 70% more food for an additional 2.3 billion people by 2050 (FAO 2009).

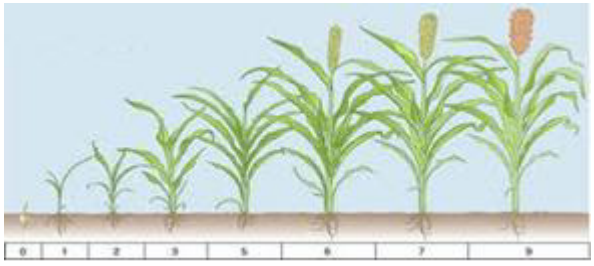
Salinity is one of the most brutal environmental factors limiting the productivity of crop plants because most of the crop plants are sensitive to salinity caused by high concentrations of salts in the soil.

One of the most effective anti-stress compounds is seaweed extract which is a bio-stimulant that has been used as soil conditioner for improving plant growth (Hurtado et al. 2009).

Marine bioactive substances extracted from marine algae are used in agricultural and horticultural crops, and many beneficial effects, in the terms of enhancement of yield and quality have been reported (Blunden, 1991; Crouch and Van Staden, 1994).

Seaweed concentrates are known to cause many beneficial effects on plants as they contain: Growth promoting hormones (IAA and IBA, cytokinins) trace elements (Fe,Cu, Zn,Co,Mo,Mn and Ni), vitamins and amino acids;

Liquid extracts derived from marine algae have been used over the past forty years on a variety of crops to promote plant growth and development;



Interest in these seaweed concentrates (SWC) in agricultural systems has focused on their use as an inexpensive source of naturally occuring plant growth regulators.

tried to characterize Moroccan macroalgae species *Ulva rigida* collected from coastal area of Akhfenir in order to evaluate their potential to

Ulva rigida
Green algae

Triticum durum
Monocotyledone specie

Globally, wheat is within the second rank among the cultivated worldwide cereals crops after maize and rice (FAO.,2018)

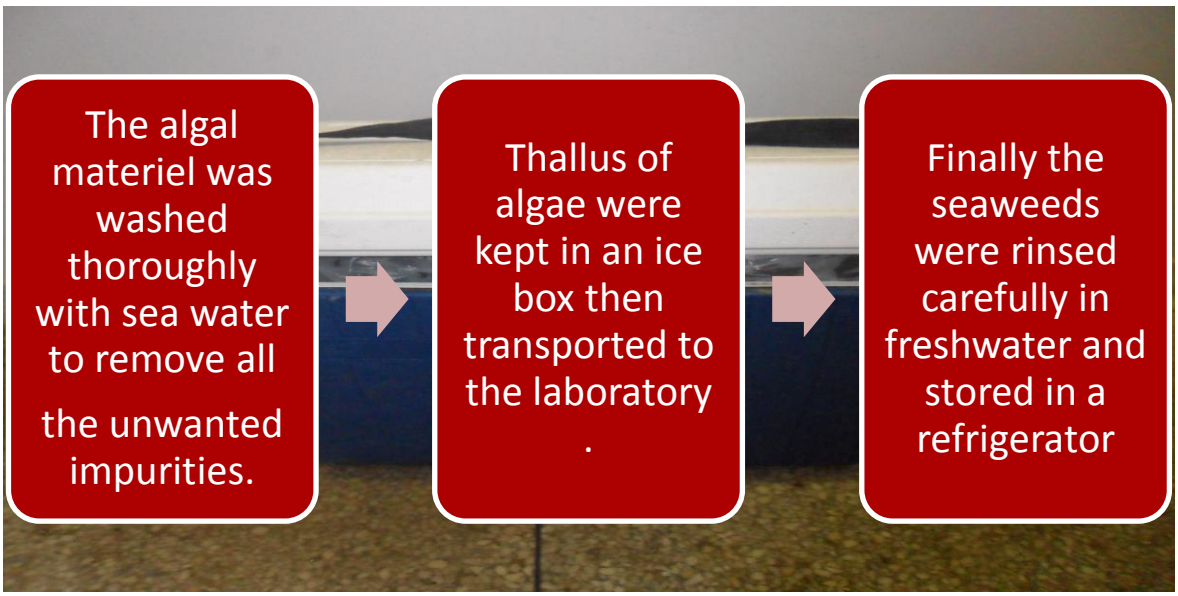
Considering the commercial importance of this plant, the physiological and biochemical effects of foliar seaweed application was analysed and therefore the results obtained on this aspect are presented in this communication.

MATERIELS AND METHODS

Collection of Seaweeds

Seaweeds “Ulva rigida belonging to the classes Chlorophyceae were hand picked from the coastal area of Akhfenir near to Laayoune city, Morocco, in March 2019.

Ulva rigida - Green algae



Preparation of Seaweed Liquid Fertilizers

- One kg of fresh seaweed material was cut into small pieces and boiled separately with a liter of distilled water for an hour and filtered through a double layered muslin cloth to remove debris (Sivasankari and al. 2006)
- The filtrate was taken as 100% concentration of the seaweed liquid extract
- Seaweed liquid extracts were prepared with differents concentrations using distilled water: 12,5%; 25% and 50%

RESULTS AND DISCUSSION

Ulva rigida Mineral elements composition
The mineral elements in the macroalgae are listed in Fig.1.
The means of macro elements showed that *Ulva rigida* is rich in Mg followed by K and Ca but low in Na and Cl.

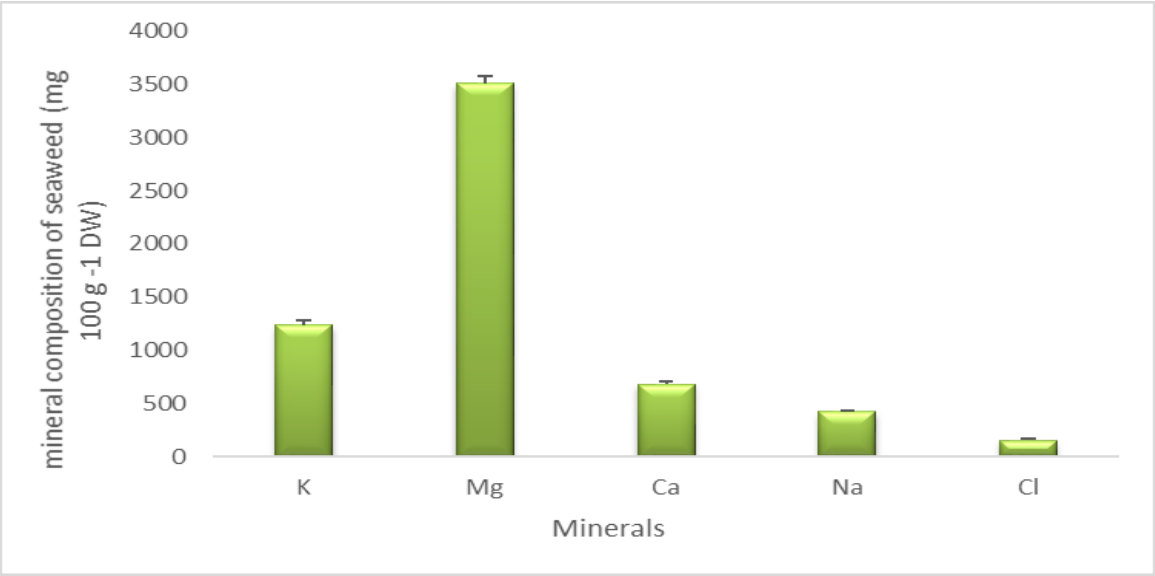


Figure (1) Mineral composition of Ulva rigida
Results are means ± S.D (n = 3) Different letters show statistically significant differences for P< 0.05.

Ulva rigida Amino Acids composition

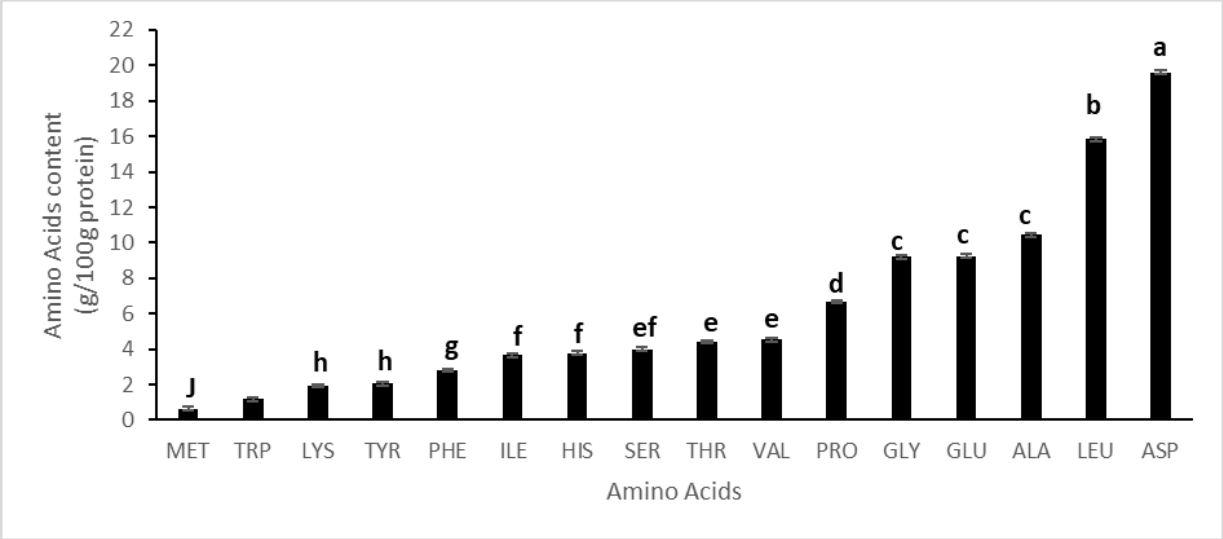


Figure (2) Amino acid content of Ulva rigida from Akhfenir coastal
Results are means ± S.D. Different letters in a single line show statistically significant differences for P< 0.05 level.

Plants Results

Table (1) The effect of Salt stress on shoot length (SL) and fresh weight (FW) of Triticum durum L. sprayed with SWE at P<0.05

	SL (cm)	**FW (g)**
B1 (0 $g.L^{-1}$ of NaCl/ 0 SWE)	$41.3+5.91^{a}$	$2.01+0.45^{a}$
B2 (2 $g.L^{-1}$ of NaCl/ 0 SWE)	$34.1+2.83^{b}$	$1.50+0.25^{ab}$
B3 (4 $g.L^{-1}$ of NaCl/ 0 SWE)	$33.14+1.56^{b}$	$1.05+0.03^{b}$
B4 (0 $g.L^{-1}$ of NaCl/ 12,5% SWE)	$39+5.65^{ab}$	$2.09+0.33^{a}$
B5(2 $g.L^{-1}$ of NaCl/ 12,5% SWE)	$38.9+2.3^{ab}$	$1.96+0.14^{a}$
B6(4 $g.L^{-1}$ of NaCl/ 12,5% SWE)	$38.7+4.08^{ab}$	$1.51+0.27^{ab}$
B7(0 $g.L^{-1}$ of NaCl/ 25% SWE)	$38+1.27^{ab}$	$1.98+0.01^{a}$
B8(2 $g.L^{-1}$ of NaCl/ 25% SWE)	$37.4+1.14^{ab}$	$1.89+0.35^{a}$
B9(4 $g.L^{-1}$ of NaCl/ 25% SWE)	$35.8+1.79^{ab}$	$1.89+0.47^{a}$
B10(0 $g.L^{-1}$ of NaCl/ 50% SWE)	$38.8+0.76^{ab}$	$1.97+0.22^{a}$
B11(2 $g.L^{-1}$ of NaCl/ 50% SWE)	$37.5+4.47^{ab}$	$1.62+0.32^{ab}$
B12(4 $g.L^{-1}$ of NaCl/ 50% SWE)	$37.5+1.87^{ab}$	$1.42+0.16^{ab}$

Results are means ± S.D (n = 3) Different letters show statistically significant differences for P< 0.05.

The foliar spraying effect of *Ulva rigida* liquid seaweed extract showed that 12,50% concentration increased significantly the growth parameters (SL/FW) of plant studied

RESULTS

A pot experiment was conducted at the greenhouse of Faculty of Sciences and Techniques of Tangier

4 weeks **8 weeks**

SaltTreatment **SaltTreatment+ SLE(%)**

Plants Results

The effect of the seaweed extracts, *Ulva rigida*, was also evaluated on the antioxidant system through the determination of enzyme activities such as SOD, GST and GR.

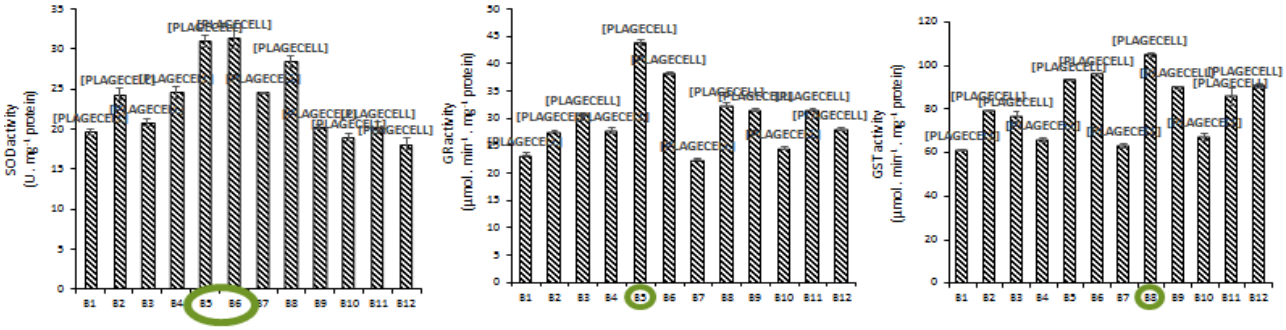


Figure (3) Effect of seaweed extract on leaves SOD, GR, GST activities of wheat plant.
Results are means ± S.D. Different letters in a single line show statistically significant differences for P< 0.05 level.

DISCUSSION

The seewead extract effect can be related to plant growth regulators:
Plant growth regulators alter cell division, root and shoot elongation, initiation of flowering, and other metabolic functions, whereas fertilizers supply minerals needed for the nutrition and normal growth of the plant .
Trace minerals present in seaweed extract may play a role in plant nutrition and physiology, probably as enzyme activators.
The beneficial effect of seaweed extract application is as a result of many components that may work synergistically at different concentrations, although the mode of action still remains unknown (Fornes et al., 2002).

PERSPECTIVES

The present investigations revealed that seaweed species were observed to be a potentiel sources of fertilizers;
The present findings encourage the application of such seaweeds as natural fertilizer in agricultural sector