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ROLE OF ULVA RIGIDA EXTRACT IN ALLEVIATION OF SALINITY STRESS ON WHEAT PLANTS

Salma Latique[1*], Reda Ben Mrid[2,3], Imad Kabach[2], Abdelaziz Yasri[3], Mohamed Nhiri[2], Mimoun El Kaoua[4], Allal Douira[1], Karima Selmaoui[1]

[1]Department of Biology, Biotechnology and Plant Protection Laboratory, Faculty of Sciences, Ibn Tofail University, Kenitra, Morocco,
[2]Laboratory of Biochemistry and Molecular Genetics, Faculty of Sciences and Techniques of Tangier, Morocco,
[3]AgroBioSciences Research Division, Mohammed VI Polytechnic University, Benguerir, Morocco,
[4]Department of Biology, Laboratory of Biotechnology and molecular bioengineering, Faculty of Sciences and Technology FSTG, Cadi Ayyad University, Gueliz-Marrakech, Morocco
**Corresponding author's e-mail: L.salma86@gmail.com*

***Abstract**: Salt stress is a major adverse factor that can lower seed germination and seedlings growth, leading to reduced plant growth and ultimately lower crop productivity in arid and semi-arid regions of the world. In order to improve crop tolerance to this abiotic stress, many research studies have the importance of seaweed extract (SWE) in alleviating stress damage to plants. Seaweed extracts are used as nutrient supplements or biofertilizers in agriculture to increase plant growth and yield. In this study, we examined the effect of liquid seaweed extracts made from Ulva rigida on the growth of durum wheat (Durum triticum L) (cv Karim) under salt stress in laboratory and greenhouse conditions using foliar applications. We assessed SWE at different concentrations (0, 12.5, 25 and 50 %) on growth parameters (shoot length and shoot fresh weight) of wheat plants. Our results indicate that plants treated with SWE of Ulva rigida at lower concentrations (12.5 %) and under moderate salt stress showed enhanced growth (better response in shoot lenght and consequently greater fresh weight). Furthermore, Ulva rigida treatments increase activities of antioxidant enzyme systems to improve the growth of wheat plants under salt stress. This study provides important information on the identification and utilization of Moroccan seaweed resources as a source of liquid extracts as biostimulants in agriculture.*

Keywords: Antioxidant enzyme, foliar application, growth, wheat plant, salt stress, Ulva rigida

INTRODUCTION

Nowadays, it is estimated that these restriction cause more than 50% of yield loss in agriculture (Acquaah 2007). Salt stress has severely affected the agricultural productivity; it is estimated that about 20% of the irrigated land is influenced by salinity in arid and semi-arid lands of the world (Yeo 1999). Salinity is a major limiting factor in agriculture production affecting different plant growth stages. In recent years, seaweed liquid extract has newly gained importance as a foliar spray for several crops, including cereals, vegetables and spices (Pramanick, 2014). Furthermore, many studies concerning plant growth stimulating

effects of marine algae are carried out (Kavipriya, 2011).
Seaweed extracts are known to contain a large range of bioactive compounds like antioxidants, plant growth hormones, osmoprotectants, mineral nutrients (Pacholczak, 2016a; Nabti, 2017). However, as is mentioned by many authors, plant growth promotion by seaweed extracts is usually observed (Latique, 2013; Latique, 2014), but the mechanisms of stimulation of plant growth aren't entirely known in many cases (Nabti, 2017).
The main objective of present study is to determine the proximate composition of the green algae *Ulva rigida* collected from the coastal area of Akhfenir and to evaluate their potential as natural fertilizer in wheat plants.

RESULTS AND DISCUSSION

To evaluate how the *Ulva rigida* extract (URE) affects wheat L. plants, some growth parameters as length and fresh weights were determined (Table 1).

Table (1) Biomass accumulation of wheat shoots growing at increased levels of *Ulva rigida* extracts.

	0%	12.5%	25%	50%
SL (cm)	32 ± 0.612^{a}	33.8 ± 1.483^{ab}	35.84 ± 1.236^{bc}	36.6 ± 2.191^{c}
FW (mg)	357.4 ± 25.706^{a}	393.8 ± 65.933^{a}	454.2 ± 44.612^{b}	416.6 ± 57.557^{a}

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

The table 1 shows the effect of URE on the growth parameters of wheat shoots. From these results, we can observe that URE contributes in a beneficial way to the growth of the wheat shoots. In fact, the length of the aerial part of the treated plants were significantly greater compared to the control plants.

The highest values of shoot length were obtained for the plants treated with 25% and 50% of URE. For the fresh weight, the seaweed extract exerted a positive effect; however, the differences between the treated plants and the control were significative only for the concentration of 25%.
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.

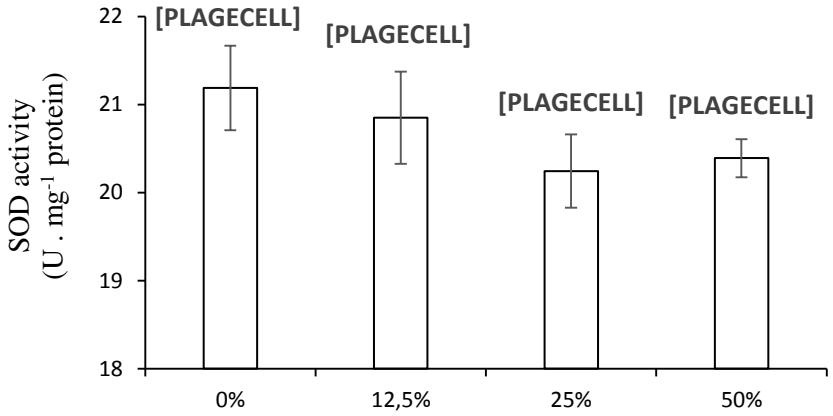

Figure (1) Effect of seaweed extract on leaves superoxide dismutase (SOD) activity of wheat plant.

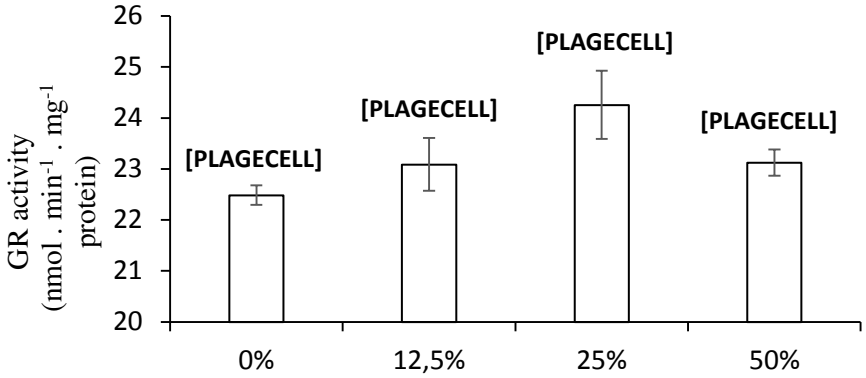

Figure (2) Effect of seaweed extract on leaves glutathione reductase (GR) activity of wheat plant.

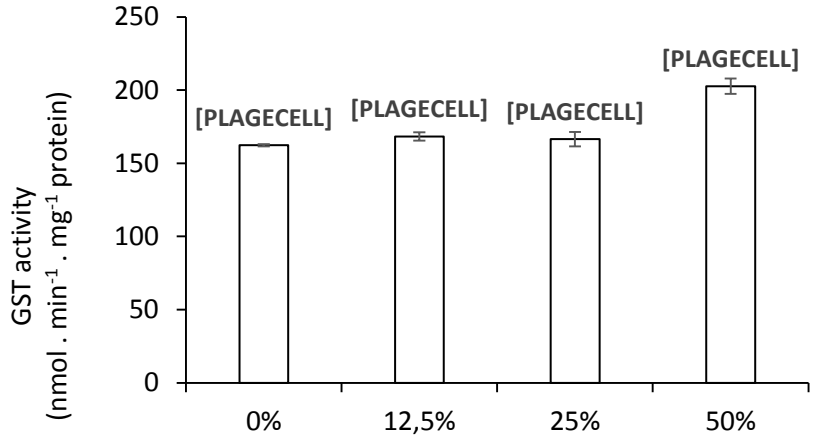

Figure (3) Effect of seaweed extract on leaves glutathione S-transferase (GST) activity of wheat plant.

Results are means ± S.D. Different letters show statistically significant differences for P< 0.05 level. In the present study, we did not observe any significance differences between the control plants and those treated with 12.5% of the seaweed extract. However, we surprisingly noticed a decrease in the SOD activity after treatment with 25% and 50% of the seaweed extract (Figure 1). Our data reveals that in leaves of wheat, the GR activity was enhanced at the concentration of 25% of URE and reaches 24.3 nmol. min^{-1}. mg^{-1} protein compared to the control with 22.5 nmol. min^{-1}. mg^{-1} protein (Figure 2). Our results indicated that GST activity increased only at the concentration of 50% of URE (Figure 3).

CONCLUSION

In the present study, we observed that the application of SWE improved notably shoot length plants in all salt treatments. This extract reduced the salt effect and enhanced the antioxidant potential of plants by activation of antioxidant enzymatic system. Extract of green SWE showed better result when they were applied at concentrations lower than 50%. This SWE can be used to improve plant growth under stress conditions. In addition, application of SWE contributes to protection of plants against peroxidation imposed by salt stress.
Consequently, the present findings encourage the application of such seaweed as natural fertilizer in agricultural sector.
As perspective It would be beneficial to carry out more research including study of antioxidant and substances active in seaweeds extract that stimulate the enzymatic system and lead to salt stress tolerance in wheat plants.This extract enhanced the antioxidant potential of plants by activation of antioxidant enzymatic system of SOD, GR, and GST which can contributes to plants protection against oxidative stress imposed by environmental stress.
Consequently, the present findings encourage the application of Moroccan green seaweed (*Ulva rigida*) as natural fertilizer in agricultural sector.