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RESEARCH ARTICLE

Physiological responses of seaweeds extracts, benzyl adenine and paclobutrazol of wheat (*Triticum aestivum* L. Cultivar Misr 1) plants.

Mohamed A. Ismail.
Botany and Microbiology Department, Faculty of Science, Al-Azhar University, Cairo, Egypt.

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****Corresponding Author***

Mohamed A. Ismail.

Abstract

This study was carried out during season of 2014/2015 at Botanical garden, Botany and Microbiology Dept., Fac. of sci., Al-Azhar Univ., Nasr City, Cairo to investigate the effect of certain algal extracts at 2g/l and 4g/l (*Sargassum latifolium*, *Ulva rigida and Corallina elongate*), Benzyladenine at 200 ppm and Paclobutrazol at 50 ppm on growth and metabolism of wheat plants. Increases in shoot length, root length and fresh and dry weights of both shoots and roots in response to all treatments. Data showed, general improvement in all yield parameters as result of algae extracts, BA and significant increases in yield of wheat plants in case of foliar treatment with pac. 50 ppm. The highest value of weight of 100 seeds is 227% and No. of seeds/plant is 136% in treated plants with Pacl. (50 ppm) as compared to control Photosynthetic pigments (chl. a, chl. b and chl. a+b) and carotenoids generally, decreased in response to all Ulva doses, Sarg. and BA 200 ppm. However, treated plants with Corallina increased pigment contents of wheat plants. With respect to Pacl. 50 ppm, chlorophylls and carotenoids significantly increased at stage 2 and decreased at stage 1.Carbohydrate contents of shoots decreased at stage 1 and increased at second stage of growth in response to all applied substances however, protein contents appeared approximate decreases in shoots of wheat plants as a result of both sea weeds, BA 200 ppm and Pacl. 50 ppm0 . Hydrolytic enzymes decreased at stage 1 and increased at the second stage of growth. Carbohydrates and phenols contents of yielded seeds of wheat plants decreased significantly in response to all applied substances in contrast, proteins in most cases increased in response to all used treatments.

Introduction:-

Wheat (*Triticum aestivum* L.), is the most important world's leading cereal crop. In Egypt wheat is considered the main crop used as source for human food. Although wheat production per unit area in Egypt has significantly increased during the past years, wheat production supplies about 40 % of its annual domestic demand only **(FAO, 2008).**

The current global scenario firmly emphasizes the need to adopt eco-friendly agricultural practices for sustainable agriculture **(Fawzy *et al*., 2012).** Organic farming is 'zero impact' on the environment **(www.seedbuzz.com).** Bio-fertilizers are low cost, effective and renewable source of plant nutrients to supplement chemical fertilizers, In addition to their role in enhancing the growth of the plants. This synergistic effect, when present, increases the role of application of bio-fertilizers in the sustainable agriculture **(Boraste *et al*., 2009).**

Fornes *et al*. (2002) reported that seaweed extract increased the yield of Clementine mandarin by 11%, while **Chouliaras *et al*. (2009)** recommended the combination of NH_4NO_3 + borax + seaweed extract in order to increase tree productivity and improve their nutrition status and various olive oil quality parameters.

Seaweeds are excellent source of vitamins A, B1, B12, C, D and A, riboflavin, niacin, pantothenic and folic acid. **Thirumaran *et al*. (2009)** reported that seaweed liquid fertilizer (SLF) contained macro nutrients, trace elements, organic substances like amino acids and plant growth regulators such as auxin, cytokinin and gibberellins. **Verklejj (1992)** stated that application of that seaweed liquid fertilizer (SLF) enhanced the water retention capacity of soil. Seaweed extracts are known to enhance seed germination, improve plant growth, induce resistance to frost, fungal and insect attack and increase nutrient uptake from soil

Thirumaran *et al*. (2009) stated that recent researches proved that seaweed fertilizers are preferred not only due to their nitrogen, phosphorus and potash content but also because of the presence of trace elements and metabolite similar to plant growth regulators. Recently, seaweed extracts as liquid fertilizers (SLF) has come in the market for the simple reason that they contain many growth promoting hormones like auxin, gibberellin, trace elements, vitamins, amino acids and micronutrients.

Strik *et al*. (2004) reported that the seaweeds extracts are effective fertilizers in many crops. **El-Barody *et al*. (2007)** found that addition of different successive extracts of *Asparogopsis taxiformis* thallus powder to the soil, as a biofertilizer, gave significant increase in the growth of *Vicia faba*. **Lozano *et al.* (1999)** stated that the application of an extract from algae to soil or foliage increased ash, protein and carbohydrate content of potatoes. **Sabh *et al.* (2008)** found that NPK in plants treated with *Sargassum* sp., reached four folds the negative control.

The using of seaweed products improve seeds germination, seedlings development, increase plant tolerance to environmental stresses **(Zhang and Ervin, 2008)**, Liquid extracts obtained from seaweeds have gained importance as foliar sprays and soil drench for many crops including various grasses, cereals, flowers and vegetable species. Also they apply to stimulate seedling germination and rooting. At present one of the most promising applications of seaweeds is their use as plant biostimulants. For example, aqueous extracts of *Sargassum johnstonii* at concentration from 0.1 to 0.8% (w/v) that is **).**The introductory soaking of *Triticum aestivun* seeds in 20% (0.2 mgSW mL-1) extracts of *Sargassum wightii* for 24 h gave an 11% increase in seed germination, a 63% enhance in number of lateral roots and 46% increase in shoots length in compare to control ***(Kumar and Sahoo, 2011).***

Seaweed extracts are often regarded as soft or natural products that can influence crop growth and development **(Norrie and Hiltz, 1999).** A wide range of beneficial effects has been observed including increasing crop yield, nutrient uptake, resistance to frost and stress conditions, longer shelf life of fruit, improved seed germination, and reduced incidence of fungal and insect attack and reduced the effect of salinity stress on membrane permeability **(Wang *et al*., 2005)**. Legumes are a major source of protein in human and animal nutrition and play a key role in crop rotations in most parts of the world. When it grows in rotation with other crops, under certain environmental conditions, they can improve soil fertility and reduce the incidence of weeds, diseases and pests (**Mwanamwenge *et al*., 1998).** Amin (2003) stated that increasing kinetin concentration on wheat plants from 10-40 mg/L increased protein, carbohydrate and oil percentage. The highest values of protein, carbohydrate and oil percentage were obtained under 20 and 40 mg/L. kinetin.

Wanas (2007) working on wheat plants, revealed that yeast and garlic extracts and benzyladenine obviously increased each of NPK, crude prolein and total carbohydrates concentrations in the flag leaf.

Tobbal (2006) revealed that kinetin (50 ppm) highly significantly increased the activity of amylases of *Zinnia* plants. Activities of proteases either insignificantly changed (in cases of the lowest and highest doses of kinetin) or highly significantly decreased (in case of the medium dose of kinetin).

In maize, paclobutrazol retarded vegetative growth, inhibited gibberellins biosynthesis, reduced cell wall, internode length, plant height, leaf area but increased the dry matter percentage and increased angle of lateral branch **(Cimen *et al*., 2004).**

Amin (2007) deduced that spraying yellow maize hybrids with paclobutrazol up to 60 mg/L resulted in significant decrease in plant height, flag leaf area, 4^{th} leaf area, leaf area index, specific leaf weight, crop growth rate and dry weight (g)/plant at the different stages of growth as compared to the untreated plants.

Mepiquate chloride and chlormequate chloride increases photosynthetic rate by increasing leaf chlorophyll content and mesophyll cell size of cotton plant which is due to more rapid exchange of CO2 into mesophyll cell by virtue of their large surface area **(Dulizhao and Derrick, 2000).**

Prusakova *et al*. (2004) deduced that the growth retarding activity of triazole compounds, such as paclobutrazole, uniconazole and azouite, by an express bioassay based on the evaluation of the α-amylase activity, which hydrolyzes starch into soluble sugars in the aleurone layer of barley (*Hordium vulgare* L.).

This study was conducted to investigate the influence of field application of seaweed extract (SWE), benzyladenine 200 ppm and paclobutrazol 50 ppm on some growth and yield criteria of wheat.

Materials and methods:-

Seeds of wheat "*Triticum aestivum* L.)" (Var. suds 1) was obtained from Agricultural Research Centre, Ministry of Agriculture, Giza, Egypt.

Algal collection:-

Sargassum latifolium (Turner) C. Agardii was collected from Hurgada Red Sea coast in June 2013 and *Ulva rigida* C. Agardii from Baltim, Mediterranean coast in June 2013. *Corallina elongate* J.Ellis was collected in May, 2013 from shallow water beside the Shore of Meditrenean Sea at Abou Quair coast in Egypt. After collection, algae were washed with fresh sea water to remove the epiphytes, sand and other extraneous matter then they were dried in shadow open air and completing the drying process in the oven at 60ºC for 5 hours. Then, dried algae were ground to fine powder by mechanic grinder. The algae were applied as a foliar treatment at the rate of 2, 4 gm powdered algae/L twice (after 30,).

Uniform wheat seeds were planted in natural loamy soil conditions in a plot (12 m width and 15 m. length) containing 9 groups representing the following treatments: *Ulva rigida* at 2 gram /liter, 4 g/liter were applied to the 2nd, 3rd respectively; *Sargassum latifolium* at 2 gram /liter, 4 g/liter were applied to the 4 th, 5 th respectively. The 6th and 7th group was treated with *Corallina elongate* at 2 gram /liter, 4 g/liter 200ppm. The 8th and 9th groups were treated with (**benzyl adenine(200 ppm), paclobutrazol(50ppm).** The first group was left aside untreated serving as control. The seeds were sown on one side of the ridge, with 10 cm apart between the hills. The in Botanical garden, Botany and Microbiology Dept., Fac. of Sci., Al- Azhar Univ., Nasr City, Cairo, Egypt, developed plants were irrigated whenever required. Concentrations of the used yeast extract, arginine and vitamin B_{12} were chosen according to a preliminary experiment in which they caused a maximum germination percentage. The plants were sprayed twice with the above mentioned treatments, the first and second were added at 33 and 70 days of plant age respectively. The plant samples were collected for analysis when the plants were 40 (Stage I) and 77 (Stage II) days old. At the end of the growth season, analysis of the seeds yielded from the different treatments and the control were done. Chlorophylls contents of were estimated using the method of **Vernon and Selly (1966)**. Carotenoids contents of were estimated according to **Lichtentahler (1981).** Soluble carbohydrates were measured according to the method of **Umbriet *et al.* (1969).** Contents of soluble proteins were estimated according to the methods of **lowery *et al*. (1951).** A phenolic compound (mg/100 g of dry wt) was carried out according to that method described by **Daniel *et al*. (1972)**. Activities of amylases were determined using the method of **Afifi *et al*. (1986).** Statistical analysis of the obtained results was done using (L.S.D.) according to **Snedecor and Cochran (1982).**

Results and Discussion:-

1-Growth parameters:-

Results in table (1) showed significant increases in shoot length of wheat plants as a result of treatment with sarg. (2 g. /l) at both stages of growth and Ulva (4g. /l), coro. (4g. /l) and Pac. 50ppm at the first stage only. However, other treatments revealed insignificant responses for shoot length.

On the other hand, data in table (1) revealed significant increases in root length at stage **I** in response to most treatments. However, at stage **II** all treatments, mostly showed stimulatory effects on root length of wheat plants. Foliar application of sea weeds extracts, BA and Pac. Showed insignificant effects on number of leaves.

The obtained results (Table 2) indicated significant increases in fresh weight of shoots of wheat plants at both stages in response to Sarg. 2g/l and and Pacl. 50 ppm however, all treatments of Ulva led to significant increases in fresh weight of roots at stage II. Foliar application of Coro, BA and Pacl appeared significant increases in fresh weight of roots at both stages of growth.

The stimulatory effects of algae extracts on growth agree with many investigators as **Verklejj (1992)** stated that application of that seaweed liquid fertilizer (SLF) enhanced seed germination, improve plant growth, induce resistance to frost, fungal and insect attack and increase nutrient uptake from soil **(Mohan et al., 1994).**

At present one of the most promising applications of seaweeds is their use as plant biostimulants. For example, aqueous extracts of *Sargassum johnstonii* at concentration from 0.1 to 0.8% (w/v) that is equivalent 1–8 mgSW mL^{-1} used as foliar spray and soil drench enhanced vegetative growth (plant height, shoot length, root length, and number of branches) and reproductive parameters (flower number, fruit number, and fresh weight) of tomato **(Kumari *et al*, 2011).** Other researchers observed the stimulatory effects of BA and growth inhibition of paclobutrazol. **Shehata *et al*. (2001), Amin (2003); Gad (2005) and Shani *et al*. (2006)** indicated that benzyladenine was used to improve sink and source capacity of wheat plants to increase grain yield. Thus, this plant growth regulator is effective in very small amount that fact as signaling to estimate growth or regulate some development programs.Pacl. In maize, paclobutrazol retarded vegetative growth, inhibited gibberellins biosynthesis, reduced cell wall, internode length, plant height, leaf area but increased the dry matter percentage and increased angle of lateral branch **(Cimen *et al*., 2004).**

2- Photosynthetic pigment:-

The present results in Table (3) observed that, mostly, contents of chl a, chl b and chl a+b of wheat plants significantly decreased as a result of Ulva 2 and insignificant response to Ulva 4 at stage **II** however, sarg 2 & 4 g/l generally, caused significant decreases in chlorophyll contents and carotenoids at stage **I** and insignificant decreases at stage II with one exception of significant increases of carotenoids for sarg 2g/l at stage II . Chlorophyll content of wheat plants generally, showed insignificant increases for coro 2 at stage **I & II** and significant increases for coro 4g /l at stage **I,** but carotenoids significantly decreased in response to coro 2g/l & 4g/l . BA mostly, led to decreases in chlorophyll content and carotenoids at both stages of growth however, Pacl 50 ppm caused significant increases in pigment content of wheat plants at all stages of growth. The obtained results are in harmony with the previous investigators for example, The effect of crude seaweed extracts of three green seaweeds (*Cladophora dalmatica*, *Enteromorpha intestinalis*, *Ulva lactuca*) and the three red algae (*Corallina mediterranea*, *Jania rubens*, *Pterocladia pinnate*) from the Egyptian Mediterranean Sea coast were studied by **El-Sheekh and El-Saied (2000)** on seed germination, growth of seedlings, chlorophyll content and other metabolic activities of *Vicia faba*. The significant improvement of carotenoids with paclobutrazol was noticed in several works for example**, Amin (2007)** working on two hybrids of yellow maize, using paclobutrazol treatments (30 and 60 mg/L) significantly increased protein, carbohydrate and carotenoid content in maize grains. The increment was directly proportional to the concentration used of paclobutrazol. **Zayed *et al*. (2005)** working on cotton plants, revealed that pix and morphactin applications significantly increased chl. a, chl. b and carotenoids content in cotton leaves as mg/dm^2 compared to control.

Some workers showed decreasing effect of BA on chlorophyll content as El-**Maadawy *et al*. (2006)** observed that the lowest BA concentration (50 ppm) caused a decrease in the total chlorophyll content of *Calendula afficinalis* L. plants compared to that of untreated plants. However, higher values of BA(100 or 150) had a fovourable effect on chlorophyll synthesis and accumulation in the leaves, and gave higher values than the control, or plants sprayed with 50 ppm BA. In both seasons, the highest total chlorophyll content was found in the leaves of plant sprayed with the medium BA concentration (100 ppm).

3- Carbohydrates, proteins and hydrolytic enzymes:-

The obtained results (Table 4) indicated that total soluble carbohydrates of shoots of wheat plants decreased significantly in response to all treatments at stage I however, this decreases convert to significant increases at stage II. Results showed that, most of applications almost, revealed significant decreases in protein contents with exception of, significant increases with Ulva (2g/l), coro. (2g/l) and BA (200 ppm) at stage II. Data in table (4) cleared that, Amylases activities increased significantly at stage I and decreased at stage II however, proteases activities decreased significantly in response to used treatments with exception of, significant increases in case of coro. (4g/l) and insignificant increases with pacl. (50ppm).The increasing in protein content was observed by many investigators **(Lozano *et al.*, 1999 Sabh *et al.*, 2008 and El-Sheekh and El-Saied, 2000).** The effect of crude seaweed extracts of three green seaweeds (*Cladophora dalmatica*, *Enteromorpha intestinalis*, *Ulva lactuca*) and the three red algae (*Corallina mediterranea*, *Jania rubens*, *Pterocladia pinnate*) from the Egyptian Mediterranean Sea coast were studied by **El-Sheekh and El-Saied (2000)** on seed germination, growth of seedlings, chlorophyll content and other metabolic activities of *Vicia faba*. They found that, all the crude extracts of seaweed increased protein content in root and shoot systems, total soluble sugars and chlorophyll content in leaves. The cytokinin content of the green algae was higher than that in red algae.

4- Yield parameters:-
Data in table (5) showed that , generally, all sea weeds extracts used, BA (200 ppm) and Pacl (50 ppm) caused increasing in spike length, spike weight, No. of seeds/plant, weight of 100 seeds and straw yield . Pacl. (50ppm) caused significant increases in all yield parameters where, straw yield increased significantly in response to all applied substances. The highest value of weight of 100 seeds is 227% and No. of seeds/plant is 136% in case of treated plants with Pacl. (50 ppm) as compared to control. The stimulatory effects of algae extracts on yield agree with a lot of investigators (**Chouliaras *et al*., 2009; Verklejj, 1992; El-Barody *et al*., 2007; Kumari *et al.*, 2011; and Norrie and Hiltz, 1999).** At present one of the most promising applications of seaweeds is their use as plant biostimulants. For example, aqueous extracts of *Sargassum johnstonii* at concentration from 0.1 to 0.8% (w/v) that is equivalent 1–8 mgSW mL^{-1} used as foliar spray and soil drench enhanced vegetative growth (plant height, shoot length, root length, and number of branches) and reproductive parameters (flower number, fruit number, and fresh weight) of tomato **(Kumari *et al*, 2011). Thamida Begum *et al*. (2011)** showed that the agronomic characters and yield components of rice

5- Carbohydrates, proteins and phenol contents of yield:-
With respect to our results in table (6) concerned to metabolites of yielded seeds of wheat plants, algae extracts, BA (200 ppm) and Pacl. (50 ppm) led to significant decreases in carbohydrate contents. Foliar application with Ulva (2g/l), Sag. (4g/l), BA (200 ppm) and Pac. (50 ppm) caused significant increases in protein content. Ulva (2g/l) and Pac. (50 ppm) revealed significant increases in total phenols of yielded seeds however, all corallina doses led to significant decreases in total phenols of wheat seeds. Stimulation of metabolite contents of yield was illustrated by **Safinaz and Ragaa (2013)** who studied the effect of three species of red marine algae (*Laurencia obtusa*, *Corallina elongata* and *Jania rubens*) as biofertilizer to enhance growth of Maize (*Zea mays* L.) plants. They found that, application of single alga or their mixture enhanced certain plant growth parameters.

Application of algae mixture caused 72.41% increase in plant dry weight and 73.97% increase in phosphorus content. However, application of *Jania rubens* alone caused 129.23% increase in the plants nitrogen content compared with control. The positive effect of paclobutrazol was observed by **Hamza *et al*. (2007)** who recorded that treating *Pelargonium zonale* with the both growth retardants (CCC or PBZ) were significantly increased the total carbohydrates content when compared with control treatment. The stimulatory responces of BA was observed by **Balbaa (2007)** who mentioned that spraying wheat plants with 75 mg/LBA gave the greatest values of crude protein percent per wheat grains.

Protein electrophoretic patterns of yield:-
SDS-PAGE in Figure (1) and results in Table (7) revealed the changes in protein patterns with total number of 27 bands with different molecular weights (MWs) ranged from about 15.64 to 198.69 KDa in the yielded wheat seeds in response to treatment with different concentrations of algal extract, BA 200ppm and Paclobutrazol 50 ppm. Results of the present study revealed that the electrophoregram of the plants treated with different concentrations of algal extract, BA 200ppm and Paclobutrazol 50 ppm exhibited the appearance of different protein bands of others presented in the control samples. The obtained results showed the presence of 19 monomorphic common polypeptide bands, 5 unique polypeptide bands and 11 polymorphic common polypeptide bands. The obtained results are in agreement with those reported by **Lozano *et al.* (1999)** stated that the application of an extract from algae to soil or foliage increased protein content of potatoes.

Conclusion:-
Application of seaweeds as well as BA 200 ppm and Pac. 50 ppm caused increased in biomass of wheat plants. The highest values of yield clearly observed with Pac. 50 ppm, 227% and 136% of weight of 100 seeds and No. of seeds / plant, respectively as compared to control plants. Carbohydrate, proteins and hydrolytic enzymes increased at stage 2 in response to most treatments. *Sargassum latifolium*. 4g/l gave the best values of protein contents in yielded seeds of wheat plants.

Table (1): Effect of *Ulva rigida*, *Sargassum latifolium*, *Corallina elongata* (g/l), and benzyl adenine, paclobutrazol (ppm) on shoot length, root length and number of leaves of *Triticum aestivum* L. (var. misr 1) plants. Values given are means of ten replicates.

Treatment	**Shoot length (cm)**		**Root length (cm)**		**Number of leaves**	
	Stage I	**Stage II**	**Stage I**	**Stage II**	**Stage I**	**Stage II**
Control (H_2O)	**37.98**	**74.91**	**10.06**	**10.80**	**5.60**	**4.14**
Ulva 2g/l	**40.26**	**78.91**	**12.56***	**12.84***	**5.40**	**5.00***
Ulva 4g/l	**43.78***	**80.41**	**12.92***	**11.74**	**5.00**	**4.29**
Sarg. 2g/l	**42.50***	**85.06***	**14.84***	**11.72**	**5.00**	**4.14**
Sarg. 4g/l	**42.26**	**73.47**	**12.08***	**11.37**	**4.60**	**4.29**
Coro. 2g/l	**39.68**	**82.44**	**11.12**	**13.58***	**4.80**	**4.28**
Coro. 4g/l	**42.98***	**79.96**	**11.66**	**13.80***	**4.80**	**4.14**
BA 200 ppm	**40.20**	**81.56**	**11.46**	**11.81**	**4.80**	**4.14**
Pac 50ppm	**42.56***	**77.19**	**12.50***	**15.37***	**5.40**	**4.00**
LSD at 0.05	**4.33**	**8.5**	**1.89**	**1.98**	**0.55**	**0.65**

* Significant at 5% confidence level.

Table (2): Effect of *Ulva rigida*, *Sargassum latifolium*, *Corallina elongata* (g/l), and benzyl adenine, paclobutrazol (ppm) on fresh and dry weight of shoots and roots of *Triticum aestivum* L. (var. misr) plants. Values given are means of ten replicates.

Treatment	**F. wt. of shoots (g.)**		**D. wt. of shoots (g.)**		**F. wt. of roots (g.)**		**D. wt. of roots (g.)**	
	Stage I	**Stage II**	**Stage I**	**Stage II**	**Stage I**	**Stage II**	**Stage I**	**Stage II**
Control	**2.66**	**6.95**	**0.25**	**1.62**	**.3620**	**0.60**	**0.03**	**0.23**
Ulva 2g/l	**2.89**	**10.07***	**0.28**	**1.78**	**.3880**	**0.90**	**0.04***	**0.46**
Ulva 4g/l	**3.57**	**9.40***	**0.33**	**1.50**	**.5660**	**0.93**	**0.05***	**0.24**
Sarg. 2g/l	**3.98***	**10.29***	**0.38**	**2.21**	**.7480**	**0.70**	**0.07***	**0.42***
Sarg. 4g/l	**3.34**	**8.77**	**0.31**	**2.27**	**.9260***	**0.71**	**0.09***	**0.37**
Coro. 2g/l	**3.22**	**8.57**	**0.30**	**2.04**	**.7800***	**1.05***	**0.07***	**0.55***
Coro. 4g/l	**3.24**	**6.51**	**0.30**	**1.65**	**.6640***	**1.32***	**0.07***	**0.47***
BA 200 ppm	**3.70**	**8.09**	**0.37**	**1.79**	**.8520***	**0.99***	**0.08***	**0.57***
Pac 50 ppm	**4.78***	**11.59***	**0.45***	**3.53***	**.9900***	**1.51***	**0.10***	**1.07***
LSD at 0.05	**1.139**	**2.39**	**0.13**	**0.85**	**0.24**	**0.36**	**0.007**	**0.26**

*Significant at 5% confidence level

Table (3): Effect of *Ulva rigida*, *Sargassum latifolium*, *Corallina elongata* (g/l), and benzyl adenine, paclobutrazol (ppm) on chlorophyll and carotenoids contents (mg/g. F. wt) of *Triticum aestivum* L. (var. misr) plants. Values given are means of three replicates

Treatment	**Chlorophyll a**	**Chlorophyll b**	**Chlorophyll a+b**	**Carotenoids**				
	Stage I	Stage II	Stage I	Stage II	Stage I	Stage II	Stage I	Stage II
Control	14.73	10.29	3.20	5.01	17.93	15.30	4.55	1.32
Ulva 2g/l	13.16	8.55*	2.42	3.84*	15.58	12.39*	4.24	1.58
Ulva 4g/l	14.41	10.96	3.00	5.17	17.42	16.13	4.62	1.47
Sarg. 2g/l	4.11*	9.45	1.11*	4.28	5.23*	13.74	1.89*	2.30*
Sarg. 4g/l	10.42*	9.19	2.42	4.20	12.84*	13.40	3.41*	1.62
Coro. 2g/l	16.60	10.69	3.02	5.31	19.62	16.00	5.38*	1.41
Coro. 4g/l	17.25*	11.24	4.69*	5.45	21.94*	16.68	5.13*	0.75*
BA 200 ppm	14.45	8.72	3.25	3.864*	17.70	12.59*	4.68	1.23
Pac 50 ppm	11.37*	13.96*	2.076*	8.14*	13.44*	22.10*	4.00	2.01*
LSD at 0.05	**2.124**	**1.687**	**0.879**	**1.025**	**3.215**	**2.014**	**0.654**	**0.451**

* Significant at 5% confidence level.

Table (4): Effect of *Ulva rigida*, *Sargassum latifolium*, *Corallina elongata* (g/l), and benzyl adenine, paclobutrazol (ppm) on total soluble carbohydrates, proteins contents and activities of amylases enzymes (mg/g. dry weight) of *Triticum aestivum* L. (var. suds 1) plants. Values given are means of three replicates.
* Significant at 5% confidence level.

Treatment	Shoot carbohydrates		Shoot proteins		Amylases		Protease	
	Stage I	Stage II	**Stage I**	**Stage II**	Stage I	Stage II	Stage I	Stage II
Control	68.61	13.85	**110.73**	**86.57**	4.31	11.42	0.369	0.279
Ulva 2g/l	58.42*	18.51	**106.30***	**97.02***	4.48	11.17*	0.350	0.201*
Ulva 4g/l	60.43*	15.21	**80.89***	**56.99***	2.82*	11.48	0.316*	0.217*
Sarg. 2g/l	45.14*	32.01*	**87.66***	**80.14***	5.13	10.76*	0.356	0.272
Sarg. 4g/l	58.70*	29.17*	**94.60***	**51.39***	6.41*	10.97*	0.340	0.237
Coro. 2g/l	45.96*	34.34*	**80.81***	**96.18***	8.82*	11.08*	0.173*	0.229*
Coro. 4g/l	22.60*	21.96*	**98.11***	**84.57**	7.17*	11.94*	0.193*	0.326*
BA 200 ppm	52.14*	18.58	**82.90***	**103.79***	6.72*	10.75*	0.290*	0.273
Pac 50 ppm	44.78*	54.15*	**90.67***	**87.49**	9.29*	11.60	0.315*	0.285
LSD at 0.05	**3.25**	**5.35**	**3.54**	**4.32**	**1.325**	**0.254**	**0.035**	**0.042**

Table (5): Effect of *Ulva rigida*, *Sargassum latifolium*, *Corallina elongata* (g/l), and benzyl adenine, paclobutrazol (ppm) on yield components of *Triticum aestivum* L. (var. misr). Values given are means of ten replicates**.**

Treatment	Length of spike	Weight of spike	wt. seeds \ spike	No. of seeds/ plant	Wt. of 100 seeds(g)	Straw yeild
Control	12.98	1.57	1.09	24.50	4.17	1.55
Ulva 2g/l	13.74	1.85	1.18	25.00	4.79	1.66
Ulva 4g/l	13.98*	1.88	1.41*	27.63	5.11	1.93*
Sarg. 2g/l	13.41	1.74	1.28	24.75	5.21	1.65
Sarg. 4g/l	14.16*	2.02	1.43*	27.13	5.40	2.08*
Coro. 2g/l	13.70	2.12*	1.34	26.75	5.59	2.00*
Coro. 4g/l	13.13	1.67	1.17	22.25	5.22	2.02*
BA 200 ppm	12.40	1.92	1.49*	25.75	5.03	1.81
Pac 50 ppm	14.14*	2.36*	1.69*	33.38*	9.47*	2.05*
LSD at 0.05	**0.91**	**0.38**	**0.30**	**6.21**	3.97	**0.29**

* Significant at 5% confidence level.

Table (6): Effect of *Ulva rigida*, *Sargassum latifolium*, *Corallina elongata* (g/l), and benzyl adenine, paclobutrazol (ppm) on total soluble carbohydrates, proteins and phenols of the seed yield of *Triticum aestivum* L. (var. misr). Values given are means of three replicates.

Treatment	Carbohydrates (mg/g)	Proteins (mg/g)	Total phenols (mg/100g)
Control	59.60	83.31	5.23
Ulva 2g/l	16.72*	98.19*	7.55*
Ulva 4g/l	20.88*	75.54*	4.78
Sarg. 2g/l	27.70*	80.72*	4.78
Sarg. 4g/l	32.33*	105.04*	4.23
Coro. 2g/l	29.21*	76.63*	0.36*
Coro. 4g/l	17.90*	84.82*	0.47*
BA 200 ppm	3.80*	98.44*	6.00
Pac 50 ppm	1.255*	90.59*	8.54*
LSD at 0.05	**0.99**	1.45	**2.14**

* Significant at 5% confidence level.

Table (7): Effect of *Ulva rigida*, *Sargassum latifolium*, *Corallina elongata* (g/l), and benzyl adenine, paclobutrazol (ppm) on protein profile in the yielded seeds of *Triticum aestivum* L. (var. misr 1).

RF	MW	control	Ulva 2	Ulva 4	Sarg.2	Sarg 4	Cora 2	Cora 4	BA 200	Pac 50	Frequency	Polymorphism
0.058	198.694	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.111	Unique
0.061	197.034	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.111	Unique
0.118	168.006	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.111	Unique
0.145	155.789	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.111	Unique
0.179	141.660	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.111	Unique
0.221	125.964	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.270	109.836	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.291	103.572	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.315	96.850	1.000	1.000	1.000	0.000	1.000	1.000	1.000	1.000	1.000	0.889	Polymorphic
0.364	84.449	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.424	71.406	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.491	59.207	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.524	53.988	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.552	49.923	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.576	46.682	0.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	0.556	Polymorphic
0.597	44.020	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.642	38.816	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.679	35.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.706	32.456	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.739	29.595	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.782	26.242	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.800	24.954	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.815	23.929	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.840	22.313	0.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	0.556	Polymorphic
0.912	18.245	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.939	16.918	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic
0.967	15.644	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	Monomorphic

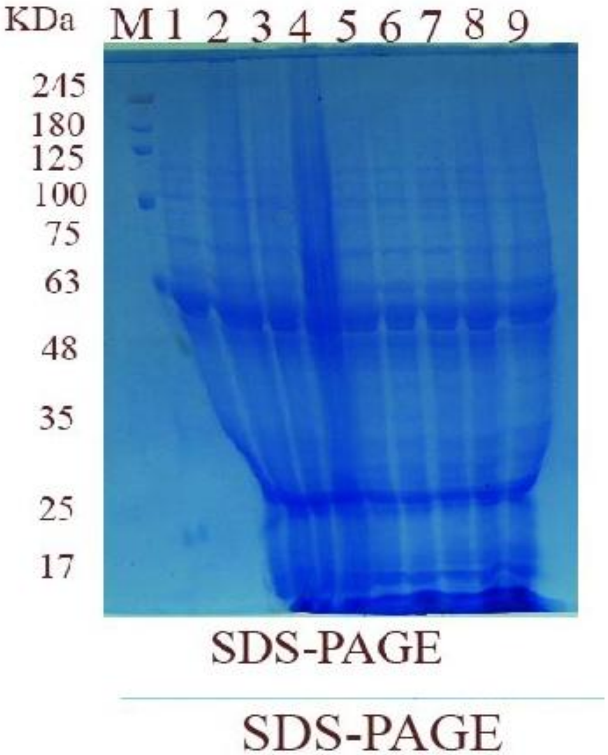

Figure (1): 1= control, **2**= *Ulva rigida* (2g/l), **3**= *Ulva rigida* (4g/l), **4**= *Sargassum latifolium* (2g/l), **5**= *Sargassum latifolium*(4g/l), **6**= *Corallina elongate*(2g/l), **7**= *Corallina elongate*(4g/l), **8**= **9**= **paclobutrazol(50ppm)**.

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