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Effect of Spraying with Seaweed Extract on Growth and Yield of Two Varieties of Wheat (*Triticum aestivum* L.)

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Abstract: A field experiment was conducted in agricultural field in Al-Rumaitha, district 25 km north of Al-Muthanna city, during the agricultural season 2017/2018. The aim was to study the effect of spray of seaweed extract at 0, 1 and 2 g.l^{-1} on growth and yield of two varieties of wheat (Bhooth 22 and Eebaa 99). The experiment was applied according to split plot design with three replicates. The results showed that the increasing of the concentration of seaweed extract up to 2 g L^{-1} in spray solution led to increase some growth properties (plant height, leaf chlorophyll concentration, flag leaf area and spike length). In addition seaweed extract up to 2 g.l^{-1} lead to increase the number of spikes/m^2, grain yield, and biological yield gave 31.85%, 39.05% and 39.79% respectively compared to the control treatment, while the concentration of seaweed extract up to 1 g.l^{-1} lead to increased 1 the number of grains per spike. The results revealed a difference in between the varieties in almost growth and reproductive traits. Bhooth 22 has the highest plant height, leaf chlorophyll concentration, spike length, and number of spikes/ m^2, grain yield (5979 kg ha^{-1}) and total biomass yield was and the highest biomass (13571 kg ha^{-1}). The interaction between spraying of seaweed extract and varieties explained a significant effect on leaf chlorophyll concertation and biomass yield.

Keywords: Seaweed, Varieties, *Triticum aestivum* L..

Introduction

Wheat *Triticum aestivum* L. is the third largest crop production in the world after corn and rice, and an essential source of calories in human, wheat comes at the second stage after rice as a main food crop; given more extensive use of maize as animal feed. Wheat is grown across a wide range of environments and is considered to have the broadest adaptation of all cereal crop species conditions and that permits large-scale cultivation and long-term storage. Currently, about 65% of the wheat crop is used for food, 17% for animal feed, and 12% in industrial applications, including biofuel. It provides for an adult person more than 50% of his energy needs and 25% of protein as well as contain

vitamins, amino acids and some mineral salts (Saudi, 2013).

One of the modern ways to grow and develop crops is to provide them with the nutrients, such as use of some organic compounds. This compound found naturally in the plant, including seaweed extracts, which is a common fertilizer used in recent times as a good source of nutrients and major and micro-growth regulators. When they spray on the plant, they increase the ability of the roots to grow, and absorb the nutrients. In addition, increase the thickness and strength of the stem as well as increase the leaf area and thus increase the root and vegetative growth (Babilie *et al*., 2015).

In one hand, the global trend is now towards decreasing the use of chemical fertilizers in order to maintain environmental health and reduce the pollution. In other hand, the use of natural compounds in plants nutrition increased in term of organic agriculture, which characterized by low toxicity, non-polluting environment, and cheap cost and have no harmful effects (Zodape *et al.,* 2010). In addition, the applying of seaweed extract promotes growth, delays leaves senescence and increases the strength of the plant because it is contain nutrients, growth regulators and some amino acids, which increases the plant's ability to absorb nutrients and increase disease resistance, which leads to increased productivity and improved quality (Spinelli *et al.,* 2010).

The success of planting of any crop depends on optimal management, effective field methods, and abundance of growth factors, especially those suitable for the environment and their adaptability to local conditions. Varieties differ in growth, production, and their response to environmental conditions depending on their genetic susceptibility. (Riaz *et al.,* 2010). Thus, this experiment was carried out with the aim of identifying the response of two varieties of wheat to spraying with different concentrations of seaweed extract.

Materials & Methods

A field experiment was conducted in one of the agricultural fields of Al-Rumaitha district 25 km north of Al-Muthanna province during the agricultural season 2017/2018 to study the effect of spraying with seaweed extract on the growth and yield of two varieties of wheat. The experiment was applied according to the design of randomized completely blocks design (R.C.B.D). The first factor included spraying with three concentrations of seaweed extract (0, 1 and 2 $g.l^{-1}$), which they are symbolized S0, S1 and S2. The second factor were two varieties of wheat Bhooth22 and IPA-99 which they are symbolized by V1 and V2. Characteristic of experimental soil were shown (Table 1).

The field of study was plowed before sowing; plowed soil was pulverized by rotavator and the soil was leveled the soil was divided according to the design used then after, the seeds were planted in 15 November. Nitrogen fertilization applied with 120 kg $N.ha^{-1}$ (as urea 46% N, phosphorus at 80 kg P2O5 ha^{-1} (46% P) (Abidi, 2011). Experimental unit ($2 \times 2 = 4$ m ^{2}) the distance between the rows 20 cm. The Acadian Seaweed Extract company, produced by Canada's Acadiansea plants Company, carried out the spray; the components are shown in table (2). The seaweed extract solutions has been spired on plants in three times, the first in the elongation phase, the second after 20 days from the first and the third after three days from the second time. The spraying process was apply in the

morning or evening to avoid high temperature. A cleaning solution was added to the spray solution to reduce the surface tension of the water and to ensure the complete wetness of the leaves in order to increase the efficiency of the spray solution. The data were statistically analyzed according to the design used in the statistical program (GenStat12) and the statistical averages were compared according to the L.S.D test under the probability level of 5% (Al-Rawi & Khalaf Allah, 2000).

Random samples of field soil were taken from depth of 0-30 cm. To measure some of physical and chemical traits of field soil (Table 2).

Table (1): Some physical and chemical characteristics of the soil before planting

Attribute		Value	Unit
pH		7.3	-
E.C		3.8	$ds.m^{-1}$
CEC		20.6	cm (+) kg^{-1}
Nitrogen Ready		18	mg kg^{-1} soil
Phosphorus Ready		8.5	mg kg^{-1} soil
Potassium ready		155	mg kg^{-1} soil
Analysis of minute volumes	sand	240	g kg^{-1}
	silt	440	
	Clay	320	
Tissue		Clay loam	

Table (2): Acadian fertilizer components containing seaweed extract.

The ingredients	Content
Sea-Weeds	50%
NPK, Metal & Ashes	40%
Amino acids	4%
Agnic acid	5-10%
Manitol	4%
Vitamins of B group B1,B2	(0.7 , 0.065) ppm

Results & Discussion

1- Plant height (cm)

The results of table (3) indicated a significant effect for seaweed extract in plant high. The highest concentration S2 gave the highest mean of plant height (82.07 cm) the concentration S1 that gave 79.53 cm. While S0 treatment gave, the lowest average of this value 76.92 cm (Table 3). The content of seaweed extract of macro and micronutrients and plant growth regulators (Table 2), which contribute to increasing the growth of the plant in general, which reflected the increase in plant height, This result is similar with what Mohammad found in his study (Mohammad, 2013). The plant high increase with the increase of spraying concentrations of seaweed extract.

The results of table (3) revealed a significant difference in between the verities in plant high. The cultivar Bhooth22 (V1) gave the highest mean of plant height, which reached 80.48 cm as compared to IPA-99 (V2), which gave the lowest mean of plant height 78.73 cm. Previous results have been found by Ali & Hamza (2013) and Al- Yasiri & Al-Samak (2015), that is the cultivars vary in plant height. The results of the interaction between the seaweed extract and the varieties, revealed no significant differences in plant height (Table 3).

Table (3): Effect of seaweed extract, varieties and their interaction in plant height (cm).

Varieties (V)	Seaweeds (S)			Varieties average
	S_0	S_1	S_2	
V_1	77.57	80.40	83.47	80.48
V_2	76.27	79.27	80.67	78.73
Seaweeds average	76.92	79.83	82.07	
L.S.D $_{0.05}$	V	S	V×S	

2- The content of the leaves of chlorophyll (SPAD)

The results table (4) displayed a significant effect for seaweed extract in the chlorophyll content in the leaves the highest concentration S2 gave the highest mean was 31.47 SPAD, with an increase of 15% from concentration S1 which gave an average of 27.33 SPAD (18%) from the control S0, which gave the lowest average chlorophyll content in the leaves was 23.17 SPAD. This increase in leaf content of chlorophyll, the elements in the extract have a role in activity of many important enzymes, especially responsible enzymes for the formation and construction of chlorophyll molecule, which contributed to the increase in content in the leaves, and this result agreed with what reached (Kasim *et al.*, 2015).

The results of table (4) revealed a significant difference in the varieties in chlorophyll content of the leaves. Bhooth22 (V1) gave the highest mean of the chlorophyll content of the leaves was 29.07 SPAD, while the IPA-99 (V2) gave the lowest average 25.58 SPAD. this results agreed with (Rekani *et al.*, 2017). The interaction treatment (V1 × S2) was the highest 34.47 SPAD, while the plants of IPA-99 (V2) gave with the control treatment of extract (V2 × S0) was 22.27 SPAD (Table 4).

Table (4): Effect of seaweed extract, varieties and their interaction in chlorophyll content (SPAD).

Varieties / Seaweeds	Seaweeds (S)			Varieties average
Varieties (V)	S_0	S_1	S_2	
V_1	24.07	28.67	34.47	29.07
V_2	22.27	26.00	28.47	25.58
Seaweeds average	23.17	27.33	31.47	
L.S.D $_{0.05}$	V	S	V× S	
	1.21	1.49	2.11	

3- Flag leaf area(cm^2)

The results table (5) presented a significant effect for seaweed extract in the area of the flag leaf. The highest concentration S2 gave the highest mean was 2680 cm^2, and significantly, higher than the second concentration of S1 which gave an average of 24.04 cm^2, which was significantly higher than the S0. The role of marine extracts in increasing the activity of many enzymes involved in phylogenetic processes as well as their role in increasing photosynthesis, which contributes to the increase of the products of this process and to better growth leading to increase the area of the flag leaf (Shahbazi *et al.*, 2015).

In case of varieties and interaction between the seaweed extract and the varieties, no significant differences were found (Table 5).

Table (5): Effect of spraying with seaweed extract and varieties and interaction between them in the area of flag leaf (cm).

Varieties / Seaweeds	Seaweeds (S)			Varieties average
Varieties (V)	S_0	S_1	S_2	
V_1	19.83	23.66	26.71	23.40
V_2	20.61	24.42	26.89	23.97
Seaweeds average	20.20	24.04	26.80	
L.S.D $_{0.05}$	V	S	V×S	
	N.S	1.21	N.S	

Table (6): Effect of spraying with seaweed extract and varieties and their overlap in the number of spike (m^2).

Varieties / Seaweeds	Seaweeds (S)			Varieties average
Varieties (V)	S_0	S_1	S_2	
V_1	363.30	421.70	466.70	417.20
V_2	316.70	395.00	430.00	380.60
Seaweeds average	340.00	408.30	448.30	
L.S.D $_{0.05}$	V	S	V×S	
	27.62	33.83	N.S	

Table (7) Effect of spraying with seaweed extract and varieties and their interaction between them in the number of grains in spike.

Varieties / Seaweeds	Seaweeds (S)			Varieties average
Varieties (V)	S_0	S_1	S_2	
V_1	52.9	59.3	62.3	58.2
V_2	55.50	68.50	63.50	62.50
Seaweeds average	54.20	63.90	62.90	
L.S.D $_{0.05}$	V	S	V×S	
	N.S	7.97	N.S	

4- Number of spike (m^2)

The results of table (6) indicated that there was a significant increase in the number of spike m^2 when increasing the concentrations of seaweed extract in the spray solution. The S1 gave the highest number of spike (m^2) 448.30 spike m^2, an increase of 10% from the second concentration which increased by 20% control treatment, which gave the number of spike was 340.00 spike m^2, this result was agreed with what found by (Kavitha *et al.*, 2008).

The results of table (6) revealed a significant difference in between the varieties in the number of spikes m^2. Bhooth22 (V1) gave an average of 417.20 spike m^2 and an increased rate of 10% for IPA-99 (V2), which gave the lowest number of spike 380.60 spike m^2, may due to genetic variation among species, this result was agreed with Al Jumelly (2011) and Al-Asseel *et al.* (2018) who pointed out the difference in wheat varieties between them in the number of spikes m^2.

5 - The number of seeds in the spike (Spike ha-1)

The results in table (7) explained the seaweed extract S1 gave the number of seeds in spike, which was 63.90-spike .ha^{-1}, which did not differ significantly from the S2 concentration, which gave an average of 62.90 spike. ha^{-1} seeds, while the control treatment (non-spray S0), gave the lowest average of this feature was 54.20 spike ha^{-1}. These results were consistent with what was indicated by (Abdul-Jabar *et al.*, 2012).

There were no significant differences between the varieties and the interaction between the seaweed extract and the varieties in the number of seeds in spike (Table 7).

6- Weight of 1000 grain (g):

The results of table (8) indicated a significant increase in the weight of 1000 grain, the treatment S0 gave the highest mean of 36.87 g, while S2 gave a mean average of 32.32 g. The decrease may be due to the increase of the extract concentrations. This resulted in a

decrease in the number of grains deposited in a single pill and then decreased in weight. However, this decrease was compensated within the spike due to the increase in the number of grains (Table 8). This result differed as indicated by Mohammad (2013).

The results showed in table (8) that, Bhooth22 (V1) significantly increased in the weight of 1000 seeds that gave the highest average of 36.47 g while the IPA-99 (V2) gave 33.27 g. These results agreed with the conclusion of Al-Hassan *et al*. (2013) and Ziydan *et al.* (2018) that indicated that the varieties differ among themselves in the weight of 1000 grains for wheat.

7- Grain yield (kg. ha^{-1})

According to table (9), there was a significant increase in grain yield with a higher concentration of the extract solution. The highest concentration S2 recorded the highest grain yield of 6501 kg. ha^{-1} while the control treatment of S0 gave the lowest mean of 4674 kg. ha^{-1}. According to the results in table (7) the number of grains in spike (table 8),

Table (8): Effect of spraying with seaweed extract and varieties and their overlap in the weight of 1000 grains (g).

Varieties / Seaweeds	Seaweeds (S)			Varieties average
Varieties (V)	S_0	S_1	S_2	
V_1	38.33	36.87	34.17	36.47
V_2	35.40	33.93	30.47	33.27
Seaweeds average	36.87	35.40	32.32	
L.S.D $_{0.05}$	V	S	V×S	
	1.12	1.38	N.S	

Table (9): Effect of spraying with seaweed extract and varieties and their overlap in grain yield (kg. ha^{-1}).

varieties / Seaweeds	Seaweeds (S)			Varieties Average
Varieties (V)	S_0	S_1	S_2	
V_1	5112	5953	6873	5979
V_2	4236	5293	6128	5219
Seaweeds average	4674	5623	6501	
L.S.D $_{0.05}$	V	S	V×S	
	391.90	480.00	N.S	

which contributed to the increase in grain yield. This result was consistent with what was obtained by Shahbazi *et al. (*2015).

The results of table (9) exhibited that Bhooth22 (V1) was significantly higher in the grain yield, which gave the highest mean of 5979 kg^{-1}. While IPA-99 (V2) gave 5219 kg^{-1}. these results agreed with the conclusion of Al-Haydary (2009) and El- Zangana & Sediq (2019).

There were no significant differences found between the extract and the varieties in Grain yield (Table 9).

8- Biological yield: (kg. ha^{-1})

The results of table (10) showed a significant increase of seaweed extract in the biological yield, the highest concentration S2 gave the highest biological yield of 14777 $kg.ha^{-1}$ while the non-spray treatment S0 gave the lowest mean of 10567 $kg.ha^{-1}$ (table 5). depended to table (5) this may be due to the grain yield in table (9), which was positively reflected in the increase in biomass. These results were consistent with what found by Kasim *et al.* (2015).

The results of table (10) revealed that (V1) recorded the highest mean of the biological value was 13574 $kg.ha^{-1}$ which increased by 5% than the IPA-99 (V2), which gave the lowest average of this feature was 11786 $kg.ha^{-1}$. The superiority of cultivar (V1) in plant height and grain yield (Table 3 & 9), which contributed to the increase of biological, this result was agreed with Hussain *et al.* (2017). The V1 cultivar, which was sprayed with the highest concentration of extract S2 (V1 × S2), gave the highest mean yield 16262 kg ha-1, while the V2 cultivar were given with the control treatment of the extract S0. In addition (V2 × S0) gave the lowest biological yield was 10050 $kg.ha^{-1}$ (Table 10).

Table (10): Effect of spraying with seaweed extract and varieties and their overlap in the biological yield (kg ha-1).

Varieties / Seaweeds	Seaweeds (S)			Varieties average
Varieties (V)	S_0	S_1	S_2	
V_1	11083	13367	16262	13571
V_2	10050	12023	13283	11786
Seaweeds average	10567	12695	14772	
L.S.D $_{0.05}$	V	S	V×S	
	598.30	732.70	1036.20	

Conclusions

1- The increasing of the concentration of seaweed extract up to 2 g.l $^{-1}$ in spray solution led to increasing some growth properties (plant height, leaf content of chlorophyll, area of flag leaf and spike length).

2- Seaweed extract up to 2 g.l $^{-1}$ leads to increase the number of spikes/m2, grain yield, and biological yield and gave 31.85%, 39.05% and 39.79% respectively compared to the control. Treatment.

3- Seaweed extract up to 1 g.l $^{-1}$ leads to increased 1 the number of grains per spike.

4- The results revealed a difference between the varieties. Bhooth 22 has the highest plant height, leaf content of chlorophyll, spike length, number of spikes.m^{-2}, grain yield (5979 kg h^{-1}), total biomass yield and the highest biomass (13571 kg h^{-1}).

5- The interaction between the spraying of seaweed extract and cultivars showed a significant effect on leaf chlorophyll content and biomass yield.

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