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ORIGINAL ARTICLE

IMPACT OF FOLIAR APPLICATION OF SEAWEED EXTRACT AND NANO HUMIC ACID ON GROWTH AND YIELD OF WHEAT VARIETIES

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Abstract: The experiment was conducted during the winter seasons 2019/2020 in a farm at Al-Rumatha district, located 25 km North Al-Muthanna province, Iraq. To study the effect of four levels of Seaumic extract as mixture of seaweed extract and nanohumica (0, 2, 4, 6 g/l) corresponding to S_0, S_1, S_2 and S_3 on growth and yield of three wheat varieties, Iraq (V_1), Buhooth-22 (V_2), Rasheed (V_3). The results showed that spraying wheat plants with 9 g /l of Seaumic extract produced the highest grain yield (7.195 t/ha), which was significantly higher over all other treatments. Variety V_3 gave the highest grain yield of 6.694 t/hawhile V_1 gave the lowest (5.733 t/ha). It can be concluded that wheat Rasheed (V_3) variety with 6 g/l could be recommend achieving maximum growth, seed yield and its components under the environmental conditions of Al-Rumatha district.

Key words: Wheat, Seaumic, Varieties, Grain yield, Harvest index.

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1. Introduction

Wheat (*Triticum aestivum* L.) is the most important among all cereals used as a food grain in many parts of the world. It is used to feed about one-third of the world population. It belongs to Poaceae family and it has been described as the “King of Cereals”. The average yield of wheat in Iraq (1760 kg/ha) is low as compared to world average (3390 kg/ha), or even to its neighbouring countries like Turkey (2500 kg/ha) and Iran (2160 kg/ha) [USDA (2019)]. Many factors are responsible for low yield of wheat, but poor crop nutrition and use of varieties with low yield potential are the most important. Recently, among the fertilization strategies, the foliar spray with different molecules like humic acid and seaweed extract is an organic nutrition [Drobek *et al*. (2019)]. At the nano-scale the matter presents altered properties, which are novel and very different from those observed at macroscopic level. The change in properties is due to the reduced molecular size and also because of changed interactions between molecules. The properties and possibilities of nano-technology, which have great interest in agricultural revolution are high reactivity, enhanced bioavailability and bioactivity, adherence effects and surface effects of nanoparticles [AL-Juthery *et al*. (2018)].

Humic acid is one of the commercial products of economic and contains many nutrient elements that lead to increase the growth and yield of many crops and It contains carbon, nitrogen, hydrogen and oxygen in varying proportions, it has positive effects on enzyme activity, plant nutrients and growth stimulant and considered a "plant food" [Burhan and AL-Taey (2018)]. Humic acid has an effect on plant growth by stimulating enzymatic reactions, increasing permeability of cellular membranes and increasing cell division and elongation [Akinci *et al.* (2009), AL-Taey *et al*. (2019)]. The addition of humic spray to plants has improved plant growth, nutrient uptake and crop growth and it is

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one of the organic plant fertilizer types that plays a major role in plant nutrition and soil fertility. It produces higher yields and healthier plants. AL-Taey and AL-Musawi (2019), Hassan *et al*. (2019) showed that when used 4 gm/l of humic fertilizer, there is a significant increase in the plant height, leaf area and ear length with an increase by 11.69, 24.89 and 3.49% respectively compared to the control treatment (H_0). Also, sea weeds extracts are used as one of the modern technologies, which have been widely used as promoters of plant growth. In comparison to chemical fertilizers, marine extracts are biodegradable, non-toxic, non-polluting and non-hazardous to humans, animals and birds. Several studies have shown that Marine algae extracts have a positive effect for growth and achieving higher agricultural production of different plant species because they contain micro and macro-nutrients and natural phytohormones [Stirk *et al*. (2014)]. Several researches have suggested that marine algae are resistant to poor environmental conditions and have the effect of increasing plant and nutrient uptake and increasing fertility [Zamani *et al.* (2013), Panda *et al.* (2012)]. In view of the advantages posed by sea weed and humic acid as the present study aims the effect of varying spraying levels of mixture of humic acid and sea weed extract on the growth, yield and yield components of Wheat varieties.

2. Materials and Methods

The experiment was conducted during the winter seasons 2019/2020 in a farm (31° 35' N latitude, 45° 10' longitude) at Al- Rumatha district, located 25 km North Al- Muthanna province, Iraq. The experiment was laid out in split-plot design with three replicates. The main plots were four levels (0, 2, 4, 6 g/l) corresponding to S_0, S_1, S_2 and S_3 of as mixture of seaweed and humic acid, which commercially available as Seaumic (Central Nano Research & Technology Co., Iran). It is a combination of a variety of plant growth factors and elements including nitrogen, phosphorus, potassium, calcium, magnesium, micronutrients (copper, iron, zinc, molybdenum and B), cytokinin, gibberellin, betaine, mannitoland amino acids) (Table 1), while the subplots were three varieties, Iraq (V_1), Buhooth-22 (V_2), Rasheed (V_3). Field was ploughed twice and levelled with ladder. Individual plots were 2×2m^2 (10 rows spaced 20 cm apart). Varieties seeds were planted on 10th November, Seed rate of 120 Kg ha^{-1}. The soil texture characterized as silty loam

Table 1: Seamuic extract contents.

Contents	Value
Humic acid%	67
Fulvic acid%	4.5
Alginic acid%	1.6
K_2O%	10.5
P_2O_5%	0.1
Micro elements(ppm) (Cu+Fe+ Zn +B+Mo)	0.3
Mannitol%	0.2
Betaine(ppm)	100
Cytokinin(ppm)	10
Gibberellin(ppm)	50
Amino acid%	1

with 19% Sand, 53% Silt and 28% Clay with EC 2.90 ds/m, pH 7.2, contained Available N, P, K 26, 9.2 and 182 mg/kg available nitrogen (N) 26 mg/kg soil, available phosphorus (P) 9.20 mg/kg soil and available potassium (K) 182 mg/ kg soil. Urea was used as nitrogen source (46%N) at 120kgN/ha [Al-Sebahi *et al* (2015)] with two doses after 15 and 60 days of sowing. Triple superphosphate (21%P) was used as phosphorus sources with one dose at the time of sowing at 80 kg P/ha. Different levels of seaumic were prepared in distilled water containing 0.1% solution of Tween-20 to increase adhesion of solution with plant foliage. First, second and third foliar application of extract was given at tillering, booting and grain filling stages respectively, while control plants were sprayed with water. Crop was harvested on 8th April. The characters measured were: Plant height, Spike length, Number of spike per m^2, Number of grains per spike, 1000 grain weight and grains yield. Also, nitrogen was determined by semi-micro Kjeldahl method while protein content for grain estimated by multiplying N% the total nitrogen of the grain with the factor 5.70.

The data averaged were analyzed statistically and differences among the treatment means were compared by using the least significant difference (LSD) test at 0.05 probability level with the help of Gen-Stat programme.

3. Results and Discussion

3.1 Effect of Seamuic foliar application and varieties on Plant growth and yield attributes

Results in Table 2 show that Seamuic caused significant differences plant height as compared to the control (sprayed by distilled water only). The treatment S4 (6 g/l) was superior affecting positively this trait

Table 2: Means of plant height, spike length, spikes/m², grains/spike, 1000 grains weight, grain yield, biological yield and harvest index as affected by Seamuic levels and varities.

Treatments		Plant height (cm)	Flag leaf area (cm²)	Spike length (cm)	Spikes/ m²	Grains / spike	1000 Grains weight (g)	Grain yield (t/ ha)	Biological yield (t/ ha)	Harvest Index %
c levels	S_1	98.51	26.44	11.4	375	42.74	44.04	5.206	11.167	46.82
	S_2	102.74	31	11.91	398. 89	45.78	45.29	6.012	12.561	47.95
	S_3	104.01	33.22	11.36	459.44	46. 30	48.22	6.458	13.499	47.85
	S_4	109.3	35.56	11.23	495.56	48.70.	49.84	7.195	14.424	49.79
LSD		2.804	2.755	N.S	41.037	N.S	2.442	0.56	0.442	N.S
Varieties	V_1	101.26	28.08	12.03	385.42	40.78	45.75	5.733	13.079	43.9
	V_2	98.3	31.75	9.38	456. 67	46.8	45.8	6.227	12.432	50.13
	V_3	111.36	34.83	13.02	454.58	50.06	49	6.694	13.227	50.26
LSD		2.07	1.512	0.717	25.191	1.119	1.592	0.426	0.439	4.504

giving 109.30 cm, while S_0 producing the lowest height averaged 99.62 cm. It could be observed that seaumic extract contents: humic acid, macronutrients, micronutrients, hormones and amino acids, which have a marked influence on the growth and plays an important role in the assimilation of wheat plants that reflected on enhancing this characteristic, which promote plant growth and cell division hence, encouraging the photosynthesis and accumulation of assimilation products. These results are agreed with those obtained by Al-Hasany *et al*. (2019) on seaweeds substance and Alabdulla (2019) on humic acid. There were significant differences between varieties, where cultivar Rasheed (V_3) gave significantly higher plant height than the other varieties. The reasons might be due to the influence of genetic structure of the genotypes. The findings of the results were supported by Khakwani *et al*. (2012) and Al-Sebahi *et al*. (2015). Data on flag leaf area are presented in Table 2. Means of the treatments for flag leaf area were significantly affected by application of Seaumic levels and varieties. Higher seaumic rate (S_4) led to an increase in the leaf area and gave 35.56 cm² with an increase by 34.49% compared with control (S_0), which gave 26.44 cm². This is due to the effect of Seaumic. On the other hand, growth enhancement may exist because seaweed extract, which contains humic acid in addition to macro and micronutrients cytokinins, gibberellins, in which that those compounds affect positively on plant's growth processes. Wheat varieties were differed in leaf area, and highest leaf area obtained from Rashid (34.83cm²), while Iraq variety scored the lowest rate (28.08cm²). This is attributed largely to the genetic variation of these varieties.

Data pertaining to spike length are presented in Table 2. Analysis of data shows that there were no significant differences between Seaumic levels on the spike length, while varieties significantly affected spike length. The results indicated that the maximum spike length (13.02 cm) was noted in crop variety V_3, while V_1 and V_2 produced spike length of 9.38 cm and 12.03 cm, respectively. It might be due to difference in the genetic characteristics [Peymaninia *et al*. (2012)]. Table 2 illustrates the significant effect of spraying different Seamuic rates have a significant effect on spikes number. Maximum number of spikes were 495.56 spike m^{-2} in S_4 treatment with no differences with S_3 (459.44 spike/m²) and the minimum number of spikes was observed in S_0 (375.00 spike/m²). The reason may be due to the high availability of nutrients, which contributes to the increase of photosynthesis products and thus increase the number of fertile branches that led to the increase in the number of spikes. Similar results have also been reported for wheat with the application of sea weed extract [Shah *et al*. (2013)]. The same table also showed that there were significant differences between the varieties in the number of spikes, V_2 variety was superior by giving the highest spikes number (456. 67spike/m²) with no significant differences with V_3 (454.58 spike/m²), while V_1 gave the lowest average of 385.42 spike/m². This results was agreed with the results of Hussain *et al*. (2016).

The data in Table 2 presented that there were significant effect of varieties on grains per spikes, but spraying different Seamuic levels was not significant on this characteristics. Maximum number of grains (50.06) was found in V_3, when minimum number of counts in grain per spike (40.78) was found in wheat variety V_1. This result is in agreement with results of some researchers Kumar (2012) and Al-Sebahi *et al.* (2015).

The results in Table 2 showed that the values of weight of 1000 Grains increased by increasing the levels of Seamuic S_1, S_2 and S_3, by 2.83, 9.49 and 13.17% respectively compared to control treatment (S_0). This may be due to Seamuic function. Also on increasing division and growth cell and increasing on photosynthetic activities and transferring photosynthesis material to grains was causing filling grain and resulted in an increase of 1000 grains weight. The genotypes were differed in 1000 grains weight, V_3 gave significantly the highest average of 49.00g compared to V_1 and V_2 varieties (45.75 and 45.80 g respectively). This result was consistent with Osman and Nor Eldein (2017) and Hussain *et al.* (2016).

Data in Table 2 revealed that the highest grain yield was observed at S_4 seaweed extract (7.195 t/ha), which was significantly higher over all other treatments. On the other hand, the lowest ones were noticed by control treatment (5.206t/ha). The increase in grain yield due to the increase in Seamuic is a result of the effect of Seamuic extract, which increasing yield components, *i.e.*, number of spikes/m^2 and 1000 grain weight which reflect positively on increase of total yield, also the positive role of humic acid which support photosynthesis as well as increase enzymatic activity and consequently increase carbohydrate synthesis, which in turn led to increase the yield [Canellas and Olivares (2014)]. The results in Table 2 indicated that the varieties significantly differed in grains yield, V_3 variety gave the highest averages of 6.694 t/ha compared to V_1 and V_2 (5.733 and 6.227t/ha, respectively). This was due to their differences in yield components (number of grains per spike and 1000 grain weight as it appear in Table 2). This is in line with Al-Sebahi *et al.* (2015) and Atab *et al.* (2019).

Data pertaining to biological yield is presented in Table 2. Analysis of data shows that seaumic levels and varieties significantly affected biological yield. Increased seaumic level from S_0 to S_4 (6 g/l) significantly increased the biological yield from 11.167 to 14.424t/ha. This increase was due to the physiological role of Seaumic extracts in growth and development of plants, which contain major and minor nutrients and bioactive substances with beneficial effects that increasing most vegetative growth traits, which was reflected in the biological yield. Maximum biological yield (13.227 t/ha) was produced in V_3 variety with no differences with V_1 variety (13.079 t/ha), while variety V_2 gave minimum value (12.432 t/ha). Table 2 showed that maximum harvest index was observed in V_3 and V_2 (50.26, 50.13% respectively), while V_1 gave the lowest (43.90%).

3.2 Effect of interaction

Impact of interaction among the experimental treatments gave insignificant differences in the majority of cases. In general, Rasheed plant that was treated with 6g/l Seaumic extract gave the highest plant height (119.9cm) (Fig.1), flage leaf area (38.67cm2) (Fig. 2),number of spikes (561.666 spike/m2) (Fig. 3),number of grains per spike (56.56) (Fig. 4) andgrain yield

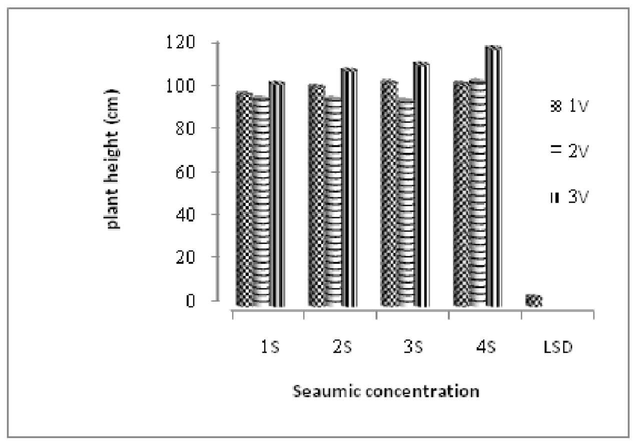

Fig. 1: Plant height of wheat varieties under different concentration of seaumic extract

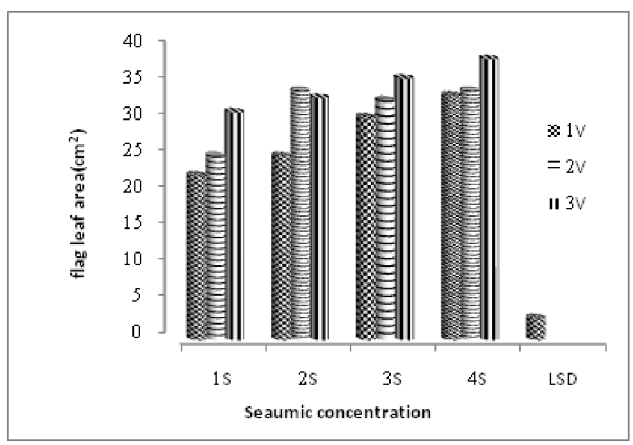

Fig. 2: Flag leaf area of wheat varieties under different concentration of seaumic extract

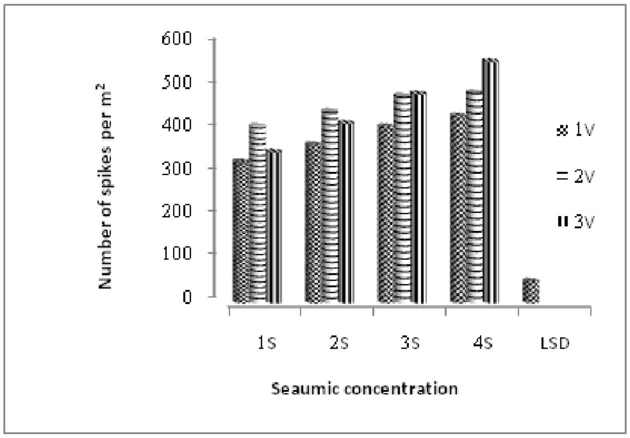

Fig. 3: Spikes/m^2 wheat varieties under different concentration of seaumic extract

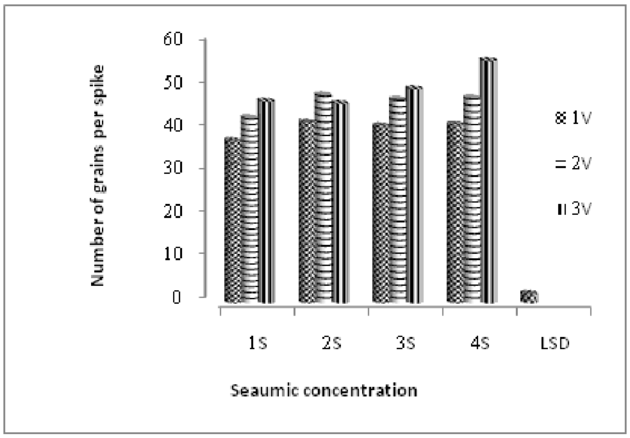

Fig. 4: Grains/spike wheat varieties under different concentration of seaumic extract

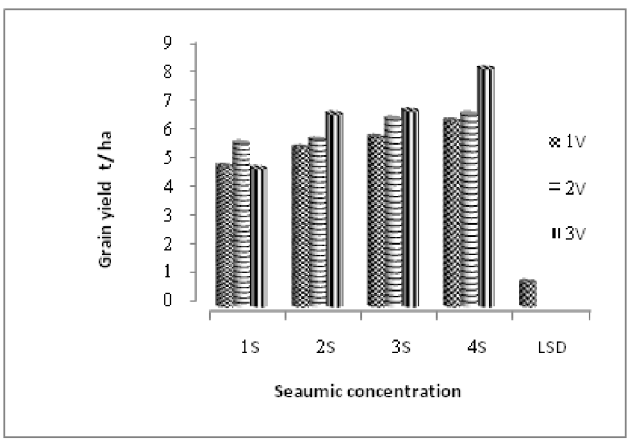

Fig. 5: Grain yield of wheat varieties under different concentration of seaumic extract

(8.340t/ha) (Fig. 5). Whereas the lowest traits were obtained from plants treated with control applied in Iraq variety. This might be due to difference in their genetic make-up of varieties to utilizes nutrients. Hence, we are going to recommend using the optimum rate of Seaumic fertilizer rate 6g/l and Rasheed variety for obtain best growth, yield and yield components.

4. Conclusion

From the experiment foliar application of Seaumic improved plant growth, yield components and yield of wheat varieties. Rashid variety was superior in all studied traits compared to the other varieties. On the other hand, Seaumic application significantly improved growth and yield in all the varieties.

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