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Behavior of Growth and Yield Bread Wheat by the Influence of Fulvic Acid and Seeing Rate

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ABSTRACT
A field experiment was carried out during winter season of 2019-2020 at College of Agricultural, University of Al-Qasim Green, Hila, Babil, Iraq to study the behavior of growth and yield bread wheat (*Triticum aestivum* L. var. Al-Rasheed) by the influence of fulvic acid and seeding rate. Randomized complete block design RCBD arranged according to split plots used at three replicates. The experiment included three seeding rate (80, 120 and 160) Kg ha^{-1} within main plots and spraying two fulvic acid concentration (3 and 6) ml L^{-1} in addition to control treatment (distilled water spraying) within sub plots. The results showed that the 160 Kg ha^{-1} seeding rate was significantly superior and gave the highest means of flag leaf area (56.9 cm^2), number of grain (44.34 grain spike^{-1}), spike weight (3.84 g spike^{-1}), grain yield (4.273 ton ha^{-1}) and biological yield (17.84 ton ha^{-1}) without significant difference on the 120 Kg ha^{-1} in these character except spike weight. Also, the spraying of fulvic acid at 6 mg L^{-1} was significantly superior and had the highest means of plant height (80.89 cm), number of grain (44.09 grain spike^{-1}), spike weight (3.50 g spike^{-1}), 1000 grain weight (33.60 g), grain yield (4.162 ton ha^{-1}) and biological yield (17.14 ton ha^{-1}) without significant difference on the spraying of fulvic acid at 3 mg L^{-1} which had the highest mean of flag leaf area (55.8 cm^2) spike weight (3.48 g). The interaction between the two factors had significant effect on all characters except spike length. We can conclude that the spraying of fulvic acid improved wheat yield by providing the necessary factors for growth and development under biotic stress conditions.

Keywords: Wheat, fulvic acid, seeding rate

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INTRODUCTION
Wheat (*Triticum aestivum* L.) is one of the most important grain crops in Iraq and the world due to its nutritional importance. The total production of wheat in Iraq reached 2,974 thousand tons with an area of 4215906 dunums (Central Organization for Statistics and Information Technology, 2017). Recently, researchers have shown great interest in increasing the yield of wheat and narrowing the gap between production and consumption by increasing the yield per unit area with vertical expansion that can be achieved through following scientific methods in agricultural practices. The seeding rate is one of the keys to important crop management, and it's a determining factor for plants in their use of available environmental resources in harmony with the cultivation environment (Lioveras *et al*., 2004), as well as being one of the agricultural processes with the greatest influence on the grain yield and its components (Ozturk *et al*., 2006). Al-Haydary (2003) indicated that the high seeding rate (160 Kg ha^{-1}) led to significant increase in the flag leaf area and biological yield of wheat without significant difference on the 120 Kg ha^{-1}, while the low seeding rate (80 Kg ha^{-1}) gave the highest mean of spike length, whereas the plant height non-significant affect by seeding rates. Al-Haydary and Baker (2006) indicated that the high seeding rate (160 Kg ha^{-1}) led to significant increase in the number of spike and grain yield and of wheat without significant difference on the 120 Kg ha^{-1}, while the low seeding rate (80 Kg ha^{-1}) gave the highest mean of number of grain per spike, whereas the 1000 grain weight non-significant affect by seeding rates. Also, the high seeding rate (175 Kg ha^{-1}) of wheat led to a significant increase in plant height, while the low seeding rate (125 Kg ha^{-1}) results in a significant increase in number of spike and 1000 grain weight of wheat (Soomro *et al*., 2009). Iqbal *et al*., (2010) found that the increasing of seeding rates (150 Kg ha^{-1} above) were significantly reduce of the number of grains per spike and grain yield of wheat. Ali and Abood (2015) stated that the seeding rate 140 Kg ha^{-1} was superiority significant in the grain yield and biological yield of wheat, while the seeding rate 100 Kg ha^{-1} recorded the highest means of number of grain per spike and 1000 grain weight. From other hand, foliar feeding technique, as a particular way to supply nutrients could results in rapid absorption and improve nutrient utilization and lower environmental pollution through reducing the amount of fertilizers added to soil (Abou El-Nour, 2002). Recently, among the fertilization strategies, the foliar spray with different molecules as fulvic acid has been introduced to improve plant growth and yields of field crops (Anjum *et al*., 2011; Lotfi *et al*., 2015 and Moradi *et al*., 2017). Humic substances enter as a supplement source for polyphenols in the early stages of plant growth, which acts as a respiratory chemical mediator and that leads to an increase in the biological activity of the plant as a result of the increase in the effectiveness of the enzymatic system, the increase in cell division, the development of the root system and the production of dry matter increases (Verlinden, *et al*., 2009 and Arjumend *et al*., 2015). In the presence of carboxyl ($COOH^-$) and phenolic (OH^-) groups, these organic complexes affect soil properties and physiological properties of plants (Robert, 2014 and Malan, 2015). Nardi *et al*., (2002) reported that the cell walls, photosynthesis and the respiration rate in plants are directly affected by humic substances. Overall, it seems that plant physiological characters are directly affected by fulvic acids, which is primarily known to enhance root growth and nutrient uptake (Eyheraguibel *et al*., 2008). Application of fulvic acid as foliar sprays can improve the growth of plant foliage, roots, and yield by increasing plant growth processes within the leaves, an increase in carbohydrates content of the leaves and stems occurs

(Khatab *et al*., 2013). Also, Ulukan (2008) indicated to that the humic substances improve yield and quality of a variety of wheat. Abd El-Kader (2016) stated that the spraying of organic acid at concentration 4 ml L^{-1} significantly increase of 1000 grain weight, grain yield and biological yield of wheat at 8.62, 26.47 and 69.91% respectively compared with control treatment. The objectives of this research to to study the behavior of growth and yield bread wheat by the influence of fulvic acid and seeding rate.

MATERIALS AND METHODS

A field experiment was carried out during winter season of 2019-2020 at College of Agricultural, University of Al-Qasim Green, Hila, Babil, Iraq in a clay loam soil as shows their some physical and chemical properties at Table 1, to study the effect of seeding rate and spray of fulvic acid on some growth, yield and it's components of wheat (*Triticum aestivum* L. var. Al-Rasheed).

Table 1. Physical and chemical soil properties in 2019-2020

Trait	2019	Unit
Sand	392	gm Kg $Soil^{-1}$
Loam	265	
Clay	353	
Ec	3.68	ds m^{-1}
pH	7.11	-----
O.M	4.6	g Kg^{-1}
Ca	18.37	Meq L^{-1}
K	1.11	
Mg	9.58	
Na	8.74	
Cl	22.87	
HCO_3	5.64	
CO_3	Nill	
SO_4	8.12	
Available N	41	mg Kg $Soil^{-1}$
Available P	13	
Available K	108	

Randomized complete block design RCBD arranged according to split plots used at three replicates. The experiment included three seeding rate (80, 120 and 160) Kg ha^{-1} within main plots and spraying two fulvic acid concentration (3 and 6) ml L^{-1} at ZGs21 and ZGs32 stages in addition to control treatment (distilled water spraying) within sub plots. Soil management especially plowing was carried out as required, and then the experiment land was divided into 27 experimental units, the area of each experimental unit was 6 m^2 which contained 10 lines, 20 cm apart. Nitrogen fertilizer was added as a urea (46% N) with an average 200 kg N ha^{-1} at three doses (1/2 at planting, 1/4 at ZGs21 and 1/4 at ZGs45) according to wheat growth stages (Table 2) (Al-Haydary, 2003), while the phosphorus fertilizer was added as a super triphosphate (46% P_2O_5) with an average 100 kg P_2O_5 ha^{-1} before the planting (Jadoo, 1995). The seeds of the wheat were sown on the 27 Nov 2019 at 5 cm depth.

Table 2. wheat growth stages

Code	Stage
ZGs21	Main stem and one tiller
ZGs32	Second node detectable
ZGs45	Boots swollen
ZGs69	Anthesis complete

Crop management were carried out as needed, and the plants were harvested after the appearance of maturity signs. The spike length (cm), number of spike per m^2, spike weight (g), number of grain per spike, 1000 grain weight (g), grain yield (ton ha^{-1}) and biological yield (ton ha^{-1}) were measured at the harvest stage, while the plant height (cm) and flag leaf area (cm^2) was measured after the flowering stage (ZGs69). The data were statistically analyzed by using Gnestat program, and least significant difference (LSD) test at 0.05 probability level was used to compare the treatment means (Steel and Torrie, 1980).

RESULTS AND DISSCUSSION

Plant height (cm)

The results at the Table 3 indicate that there are non-significant differences among seeding rates in plant height. These results are in agreement with Al-Haydary (2003) who found non-significant differences among seeding rates in plant height of wheat. Data at the Table 3 indicate that the plant height was significantly affected by fulvic acid concentrations. The spraying of fulvic acid at 6 mg L^{-1} gave the highest mean 80.89 cm without significant difference with the 3 mg L^{-1} of fulvic acid (76.33 cm), while the control treatment (spraying of distilled water) gave the lowest mean 71.11 cm. The reason of the superiority of fulvic acid spray compared with control treatment could be due to its role in an increase the biological activity of the plant as a result of the increase the effectiveness of the enzymatic system which was reflect on the cell division and elongation and then an increasing the plant growth (Arjumend *et al*., 2015). These results are in agreement with Khatab *et al*., (2013). The interaction between two factors had significant effect on the plant height, the seeding rate 160 Kg ha^{-1} with fulvic acid at 6 mg L^{-1} gave the highest value 85.00 cm without significant differences on the same seeding rate with at 3 mg L^{-1} of fulvic acid

(83.00 cm) and seeding rates 120 and 80 Kg ha^{-1} with 6 mg L^{-1} of fulvic acid (82.00 and 75.67 cm), respectively, while the seeding rate 80 Kg ha^{-1} with control treatment gave the lowest value 67.33 cm (Table 3).

Table 3. Effect of Seeding Rates and Spraying of Fulvic Acid on The Plant Height of Wheat (cm)

Seeding Rates (Kg ha^{-1})	Fulvic Acid Concentration (mg L^{-1})			Mean
	0	3	6	
80	67.33	75.00	75.67	72.67
120	71.33	71.00	82.00	74.78
160	74.67	83.00	85.00	80.89
Lsd 0.05	9.66			N. S
Mean	71.11	76.33	80.89	
Lsd 0.05	5.5			

Flag Leaf Area (cm^2)

The results at the Table 4 indicate that the seeding rates had significantly affect the flag leaf area. The 160 Kg ha^{-1} treatment gave the highest mean 56.9 cm^2 without significant difference with the 120 Kg ha^{-1} treatment (50.4 cm^2), whereas the 80 Kg ha^{-1} treatment gave the lowest mean 47.1 cm^2. The superiority of the high seeding rates may be due to their highest plant height (Table 3), which led to the plants being exposed to the largest amount of solar radiation and thus increasing the flag leaf area. These results are in agreement with Al-Haydary (2003) who found that the high seeding rates were significantly superior in the flag leaf area of wheat compared with low seeding rate. Data at the Table 4 show that the flag leaf area was significantly affected by fulvic acid concentrations, the spraying of fulvic acid at 3 mg L^{-1} had the highest mean 55.8 cm^2 compared with control treatment which had the lowest mean 45.1 cm^2. The reason for the superiority of plants sprayed with fulvic acid compared with control treatment may be due to the role of humic compounds, including fulvic acid, in stimulating plant growth which acts as a respiratory chemical mediator and that leads to an increase in the biological activity of the plant as a result of the increase in the effectiveness of the enzymatic system and cell division (Arjumend *et al.*, 2015), as well as, Eyheraguibel *et al.*, (2008) reported that the plant physiological characters are directly affected by fulvic acids, which is primarily known to enhance root growth and nutrient uptake and then stimulating of plant growth. These results are harmony with Khatab *et al.*, (2013) who found that the application of fulvic acid as foliar sprays can improve the growth of plant by increasing the biochemical processes within the leaves. The interaction between two factors had significant effect on the flag leaf area, the seeding rate 160 Kg ha^{-1} with 3 mg L^{-1} of fulvic acid gave the highest value 59.4 cm^2 without significant differences on the same seeding rate with control treatment (51.9 cm^2) and seeding rates 120 with fulvic acid at 3 and 6 mg L^{-1} (54.1 and 58.8 cm^2) respectively, and 80 Kg ha^{-1} with fulvic acid at 3 mg L^{-1} (53.8 cm^2), while the seeding rate 120 Kg ha^{-1} with control treatment gave the lowest value 38.2 cm^2 (Table 4).

Table 4. Effect of Seeding Rates and Spraying of Fulvic Acid on The Flag Leaf Area of Wheat (cm^2)

Seeding Rates (Kg ha^{-1})	Fulvic Acid Concentration (mg L^{-1})			Mean
	0	3	6	
80	45.1	53.8	42.5	47.1
120	38.2	54.1	58.8	50.4
160	51.9	59.4	59.3	56.9
Lsd 0.05	13.1			8.4
Mean	45.1	55.8	53.5	
Lsd 0.05	8.1			

Spike Length (cm)

According to table 5 results, there are non-significant differences have been found in spike length among seeding rates, fulvic acid concentrations and the interaction between them.

Table 5. Effect of Seeding Rates and Spraying of Fulvic Acid on The Spike Length of Wheat (cm)

Seeding Rates (Kg ha^{-1})	Fulvic Acid Concentration (mg L^{-1})			Mean
	0	3	6	
80	12.00	12.33	12.67	12.33
120	14.00	13.00	14.33	13.78
160	14.67	14.67	14.33	14.65
Lsd 0.05	N. S			N. S
Mean	13.78	13.33	13.56	
Lsd 0.05	N. S			

Number of Spike m^{-2}

The differences in number of spike among seeding rates and fulvic acid concentrations have been found non-significant, while the interaction between two factors had significant effect on the number of spike (Table 6), the seeding rate 120 Kg ha^{-1} with fulvic acid at 3 mg L^{-1} recorded the highest value 423.0 spike m^{-2} compared with seeding rate 120 Kg ha^{-1} with control treatment which recorded the lowest value 324.0 spike m^{-2}.

Table 6. Effect of Seeding Rates and Spraying of Fulvic Acid on The Number of Spike (Spike m^{-2})

Seeding Rates (Kg ha^{-1})	Fulvic Acid Concentration ($mg\ L^{-1}$)			Mean
	0	3	6	
80	330.0	332.3	334.0	332.10
120	324.0	423.0	349.0	365.40
160	357.7	366.3	409.0	377.70
Lsd 0.05	61.66			N. S
Mean	364.00	374.00	337.20	
Lsd 0.05	N. S			

Number of Grain spike^{-1}

According to the results at the Table 7, the seeding rates had significantly affected the number of grains per spike. The 160 Kg ha^{-1} treatment gave the highest mean 44.34 grain $spike^{-1}$ without significant difference on the 120 Kg ha^{-1} treatment (43.56 grain $spike^{-1}$), whereas the 80 Kg ha^{-1} treatment gave the lowest mean 40.72 grain $spike^{-1}$. The reason for the superiority of the high seeding rates may be due to they are superior in the flag leaf area (Table 4), i.e., an increase in the efficiency of the photosynthesis process and its metabolites and transfer to the reproductive parts, which led to an increase in the number of fertilized florets and then an increase in the number of grains per spike. The positive significant correlation between the number of grains per spike and the flag leaf area (r = 0.5089) confirms these results (Table 12). These results are in agreement with Iqbal *et al*., (2010) who reported that the high seeding rates were significantly superior in the number of grains per spike of wheat. Data at the Table 7 show that the number of grain per spike was significantly affected by fulvic acid concentrations, the spraying of fulvic acid at 6 mg L^{-1} had the highest mean 44.09 grain $spike^{-1}$ without significant difference on the 3 mg L^{-1} (43.66 grain $spike^{-1}$), while the control treatment had the lowest mean 40.88 grain $spike^{-1}$. The regularity of feeding increases the formation of grains in one spike as a result of the increased occurrence of fertilization of florets and then an increase in the number of grain per spike, as well as the role of spraying organic acids, including fulvic acid, and their content of micronutrients in raising the efficiency of the representation process and providing an appropriate opportunity to reduce the state of abortion in florets as a result of reducing competition among them on the photosynthetic products (Geith *et al*., 1989, Khalaf *et al*., 2017). Similar findings have been reported by Khan and Mir (2002). The interaction between two factors had significant effect on the number of grain per spike, the seeding rate 160 Kg ha^{-1} with fulvic acid at 6 mg L^{-1} gave the highest value 45.97 grain $spike^{-1}$ without significant differences on the same seeding rate with 3 mg L^{-1} of fulvic acid (45.03 grain $spike^{-1}$) and 120 Kg ha^{-1} with 3 mg L^{-1} of fulvic acid (44.50 grain $spike^{-1}$), while the seeding rate 80 Kg ha^{-1} with control treatment had the lowest value 38.53 grain $spike^{-1}$ (Table 7).

Table 7. Effect of Seeding Rates and Spraying of Fulvic Acid on The Number of Grain per Spike

Seeding Rates (Kg ha^{-1})	Fulvic Acid Concentration ($mg\ L^{-1}$)			Mean
	0	3	6	
80	38.53	41.43	42.20	40.72
120	42.07	44.50	44.10	43.56
160	42.03	45.03	45.97	44.34
Lsd 0.05	1.83			1.62
Mean	40.88	43.66	44.09	
Lsd 0.05	0.93			

Spike Weight (g spike^{-1})

The results at the Table 8 show that the seeding rates had significantly affect the spike weight. The 160 Kg ha^{-1} treatment recorded the highest mean 3.84 g $spike^{-1}$ compared with 80 Kg ha^{-1} treatment which recorded the lowest mean 2.54 g $spike^{-1}$. Data at the Table 8 indicate that the spike weight was significantly affected by fulvic acid concentrations, the spraying of fulvic acid at 6 mg L^{-1} had the highest mean 3.50 g $spike^{-1}$ without significant difference on the spraying of fulvic acid at 3 mg L^{-1} (3.37 g $spike^{-1}$), while the control treatment had the lowest mean 2.98 g $spike^{-1}$. The reason for the superiority of the 160 Kg ha^{-1} and / or the spraying of fulvic acid at 6 mg L^{-1} may be due to its superiority in the number of grains per spike (Table 7) which was result in an increasing of spike weight. The positive significant correlation between spike weight and the number of grains per spike (r = 0.5593) confirms these results (Table 12). The interaction between two factors had significant effect on the spike weight, the seeding rate 160 Kg ha^{-1} with fulvic acid at 6 mg L^{-1} gave the highest value 4.23 g $spike^{-1}$ without significant difference on the same seeding rate with fulvic acid at 3 mg L^{-1} (3.85 g $spike^{-1}$), while the seeding rate 80 Kg ha^{-1} with control treatment gave the lowest value 2.33 g $spike^{-1}$ (Table 8).

Table 8. Effect of Seeding Rates and Spraying of Fulvic Acid on The Spike Weight (g spike-1)

Seeding Rates (Kg ha-1)	Fulvic Acid Concentration (mg L-1)			Mean
	0	3	6	
80	2.33	2.70	2.60	2.54
120	3.19	3.56	3.67	3.47
160	3.43	3.85	4.23	3.84
Lsd 0.05	0.43			0.35
Mean	2.98	3.37	3.50	
Lsd 0.05	0.28			

1000 Grain Weight (g)

The differences in 1000 grain weight among seeding rates have been found non-significant (Table 9). Data at the Table 9 show that the 1000 grain weight was significantly affected by fulvic acid concentrations, the spraying of fulvic acid at 6 mg L^{-1} had the highest mean 33.60 g without significant difference with 3 mg L^{-1} of fulvic acid (33.10 g), while the control treatment which had the lowest mean 31.93 g. The increase of the weight of 1000 grain when spraying fulvic acid may be due to its role in raising the efficiency of the photosynthesis process and increasing its products and transferring to the sink which led to an increase the weight of the spike (Table 8) and then an increasing 1000 grain weight. These results are in agreement with Abd El-Kader (2016) who found that the spraying of organic acid substance led to significant increasing of the 1000 grain weight of wheat. The interaction between two factors had significant effect on the 1000 grain weight, the seeding rate 160 Kg ha^{-1} with fulvic acid at 6 mg L^{-1} gave the highest value 34.90 g without significant difference on the same seeding rate with fulvic acid at 3 mg L^{-1} (33.97 g) and seeding rate 120 Kg ha^{-1} with fulvic acid at 6 mg L^{-1} (33.47 g), while the seeding rate 80 Kg ha^{-1} with control treatment gave the lowest value 31.40 g (Table 9).

Table 9. Effect of Seeding Rates and Spraying of Fulvic Acid on the 1000 Grain Weight (g)

Seeding Rates (Kg ha-1)	Fulvic Acid Concentration (mg L-1)			Mean
	0	3	6	
80	31.40	32.27	32.43	32.03
120	32.43	33.07	33.47	32.99
160	31.97	33.97	34.90	33.61
Lsd 0.05	1.75			N. S
Mean	31.93	33.10	33.60	
Lsd 0.05	1.16			

Grain Yield (ton ha-1)

The results at the Table 10 indicate that the seeding rates had significantly affect the grain yield. The 160 Kg ha^{-1} treatment gave the highest mean 4.273 ton ha^{-1} without significant difference with the 120 Kg ha^{-1} treatment which gave 3.874 ton ha^{-1}, whereas the 80 Kg ha^{-1} treatment gave the lowest mean 3.257 ton ha^{-1}. The superiority of the 160 Kg ha^{-1} may be due to increase the number of plants per area unit, as well as the seeding rate 160 Kg ha^{-1} gave the best results of the number of grain per spike (Table 7) and spike weight (Table 8). These results are in agreement with Al-Haydary and Baker (2006), Soomro *et al.*, (2009), Iqbal *et al.*, (2010) and Ali and Abood (2015) who found that the high seeding rates were significantly superior in the grain yield of wheat compared with low seeding rate. Data at the Table 10 show that the grain yield was significantly affected by fulvic acid concentrations, the spraying of fulvic acid at 6 mg L^{-1} recorded the highest mean 4.162 ton ha^{-1} without significant difference with the spraying of fulvic acid at 3 mg L^{-1} (3.921 ton ha^{-1}), while the control treatment had the lowest mean 3.321 ton ha^{-1}. The superiority of the spraying the fulvic acid at 6 mg L^{-1} may be due to superior in the number of grain per spike (Table 7), spike weight (Table 8) and 1000 grain weight (Table 9) which that led to increase the grain yield. The positive significant correlation between grain yield and number of grains per spike (r = 0.6731), spike weight (r = 0.4661) and 1000 grain weight (r = 0.6735) confirms these results (Table 12). These results are harmony with Ulukan (2008) and Abd El-Kader (2016) who found that the spraying of organic acid led to significant increasing of the wheat grain yield. The interaction between two factors had significant effect on the grain yield, the seeding rate 160 Kg ha^{-1} with fulvic acid at 6 mg L^{-1} treatment gave the highest value 4.903 ton ha^{-1} without significant difference on the same seeding rate with fulvic aicd at 3 mg L^{-1} (4.642 ton ha^{-1}), while the seeding rate 80 Kg ha^{-1} with control treatment gave the lowest value 2.987 ton ha^{-1} (Table 10).

Table 10. Effect of Seeding Rates and Spraying of Fulvic Acid on The Grain Yield (ton ha-1)

Seeding Rates (Kg ha-1)	Fulvic Acid Concentration (mg L-1)			Mean
	0	3	6	
80	2.987	3.353	3.430	3.257
120	3.703	3.767	4.153	3.874
160	3.273	4.642	4.903	4.273
Lsd 0.05	0.502			0.460
Mean	3.321	3.921	4.162	
Lsd 0.05	0.244			

Biological Yield (ton ha^{-1})

The results at the Table 11 show that the seeding rates had significantly affect the biological yield. The 160 Kg ha^{-1} treatment had the highest mean 17.84 ton ha^{-1} without significant difference with the 120 Kg ha^{-1} treatment which had 16.50 ton ha^{-1}, whereas the 80 Kg ha^{-1} treatment had the lowest mean 13.37 ton ha^{-1}. The superiority of the 160 Kg ha^{-1} may be due to increase the number of plants per area unit, in addition to the seeding rate 160 Kg ha^{-1} gave the highest means of the flag leaf area (Table 4), number of grain per spike (Table 7), spike weight (Table 8) and grain yield (Table 10). The positive significant correlation between grain yield and these characters (r = 0.5529, 0.8231, 0.6632 and 0.7995 respectively) confirms these results (Table 12). These results are in agreement with Al-Haydary (2003) and Ali and Abood (2015) who found that the high seeding rates gave the best results of the biological yield of wheat. Data at the Table 11 show that there are significant difference among fulvic acid concentrations (0, 3 and 6 mg L^{-1}) in the biological yield of wheat, the spraying of fulvic acid at 6 mg L^{-1} recorded the highest mean 17.14 ton ha^{-1} without significant difference on the spraying of fulvic acid at 3 mg L^{-1} (16.58 ton ha^{-1}), while with control treatment recorded the lowest mean 13.98 ton ha^{-1}. The superiority of the spraying the fulvic acid at 6 mg L^{-1} could be due to superior in the plant height (Table 3), number of grain per spike (Table 7), spike weight (Table 8), 1000 grain weight (Table 9) and grain yield (Table 10). These results are harmony with Ulukan (2008) who reported that the increment in growth parameter and yield may be due to that the humic substances are extremely important component because they constitute a stable fraction of carbon, thus regulating the carbon cycle and release of nutrients, including nitrogen, phosphorus, and sulfur, as well as stimulates the assimilation of major and minor elements, enzyme activation and/or inhibition, changes in membrane permeability, protein synthesis and finally the activation of biomass production. Also, these results are in agreement with Abd El-Kader (2016) who found that the spraying of organic acid led to significant increasing of the biological yield of wheat. The interaction between two factors had significant effect on the biological yield, the seeding rate 160 Kg ha^{-1} with fulvic acid at 6 mg L^{-1} gave the highest value 19.48 ton ha^{-1} without significant difference on the same seeding rate with fulvic aicd at 3 mg L^{-1} (18.72 ton ha^{-1}) and the seeding rate 120 Kg ha^{-1} with fulvic acid at 6 and 3 mg L^{-1} (17.78 and 17.51 ton ha^{-1}), while the seeding rate 80 Kg ha^{-1} with control treatment gave the lowest value 12.44 ton ha^{-1} (Table 11).

Table 11. Effect of Seeding Rates and Spraying of Fulvic Acid on The Biological Yield (ton ha^{-1})

Seeding Rates (Kg ha^{-1})	Fulvic Acid Concentration (mg L^{-1})			Mean
	0	3	6	
80	12.44	13.52	14.17	13.37
120	14.20	17.51	17.78	16.50
160	15.31	18.72	19.48	17.84
Lsd 0.05	2.37			1.60
Mean	13.98	16.58	17.14	
Lsd 0.05	1.09			

Table 12. The Correlation Between Characters

	P. H.	FLA	SL	No. S	No. G	SW	1000 GW	GY
FLA	0.3948							
SL	0.2128	0.1751						
No. S	0.2140	0.1562	0.1527					
No. G	0.4958	0.5089	0.3583	0.6087				
SW	0.3683	0.3942	0.5660	0.2918	0.5593			
1000 GW	0.5628	0.2616	0.0752	0.7113	0.7370	0.3038		
GY	0.5587	0.3459	0.2916	0.4368	0.6731	0.4661	0.6735	
BY	0.4828	0.5529	0.3569	0.5145	0.8231	0.6632	0.6425	0.7995

P. H. = Plant Height, FLA = Flag Leaf Area, SL = Spike Length, No. S = Number of Spike, No. G = Number of Grain, SW = Spike Weight, 1000 GW = 1000 Grain Weight, GY = Grain Yield, BY = Biological Yield.

CONCLUSION

As it is known, seeding rate is one of the vital factors in the growth and production of crops through its effect on the growth pattern. Cultivation with a high seeding rate means increased competition among plants for growth factors such as light, water and nutrients. Therefore, in order to reduce the harmful effect of competition among plants and achieve the best high economic return, we can follow several methods, including spraying organic acids such as fulvic acid, which appeared through the results to improve the growth of the wheat crop by providing the necessary nutrients as well as stimulating plants to exploit available growth factors such as light. Water and nutrients for plant growth and development under conditions of biotic stress.

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