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Response of bread wheat Cultivars to different levels of humic acid fertilizer in Tikrit city environment

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ABSTRACT

A field experiment was carried out during the winter season 2022-2023 at the Field Crops Research Station (FCRS), located at Agriculture College, Tikrit University in a gypsum soil, to investigate the effect of humic acid on wheat growth, development, and yield. By Using the Randomized Complete Block Design (RCBD), Split-plot, with three replications, three levels of humic acid, 0, 20 and 40 kg.h^{-1}, were located at the main block and fifteen cultivars of wheat, Sham 6, Sham 8, Eba 95, Eba 99, Tammuz 2, Tammuz 3, Karada, AlEzz, Maxibac, Abu Ghraib 3, Al-Fateh, Intisar, Latifa, Bohoath 22 and Rashid, were located at the secondary blocks, the experiment was applied. The number of days to expel the spikes, the number of active tillers, the number of spikes were calculated, and flag leaf area, plant height, and 1000 grains weight were measured. The result indicated that the level 40 kg.h^{-1} of humic acid significantly had a higher impact for all traits compared with the other two levels. As well as, Eba 99 and Tammuz 2 were significantly higher in all traits compared with other verities. The interaction between the third level and the two above-mentioned varieties was significant in most of the traits, especially the number of grains per spike (65.33 and 65.33 grains per spike^{-1}) and the yield (7.85 and 8.42 tons h^{-1}), respectively. According to the results, we suggested using 40 kg.h^{-1} and the cultivars Eba 99 and Tammuz 2 to plant in the gypsum soil conditions.

استجابة أصناف قمح الخبز لمستويات مختلفة من سماد حامض الهيوميك في بيئة مدينة تكريت

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الخلاصة

نفذت تجربة حقلية خلال الموسم الشتوي 2022/2023 في محطة أبحاث المحاصيل الحقلية كلية الزراعة/جامعة تكريت في تربة جبسية، طبقت التجربة بترتيب الالواح المنشقة ووزعت المعاملات حسب التصميم المستخدم RCBD في ثلاث مكررات، وكانت عوامل التجربة (الالواح الرئيسية) ثلاث مستويات إضافة من حامض الهيومك 0، 20، 40 كغم هـ$^{-1}$، واحتلت الأصناف شام8، اباء99، تموز2، كريطة، العز، اباء95، مكسيباك، شام6، ابوغريب، الفتح، انتصار، لطيفية، تموز3، بحوث22، رشيد، الالواح الثانوية، ودرست صفات عدد الأيام لطرد السنابل ومساحة ورقة العلم وارتفاع النبات وعدد الاشطاء الفعالة وعدد حبوب السنبلة ووزن 1000 حبة والحاصل، وقد أظهرت النتائج الى تفوق المستوى الثالث من حامض الهيومك ولجميع الصفات المدروسة، وكان الصنفين اباء99 وتموز2 متفوقين في اغلب الصفات المدروسة، وكان التداخل بين المستوى الثالث مع الصنفين أعلاه معنويا في معظم الصفات لاسيما صفتي عدد حبوب السنبلة 65.33 و65.33 حبة سنبلة$^{-1}$، والحاصل 7.85 و8.42 طن هـ$^{-1}$على الترتيب، لذا نقترح بضرورة استخدام الصنفين اعلاه مع عوامل زراعية أخرى لمعرفة اقصى إنتاجية تحت ظروف الترب الجبسية.

الكلمات المفتاحية: صفات النمو والحاصل، حامض هيومك ،الأصناف، حنطة الخبز.

INTROUCTION

Wheat (*Triticum aestivum* L.) belongs to the Poaceae family, is one of the main and important cereal crops in the world. It counted as a top of strategic food crops that is most widespread in the global. Its seed is the most important source of amino acids, essential vitamins, minerals, dietary fiber, and beneficial phytochemicals (Shewry, 2009). Wheat production in Iraq was over 2.17 million tons, and it rated 88.9% of the total grain seed production in Iraq (Directorate of Agricultural Statistics, 2018). Although Iraq is the one of original places for wheat, wheat production still less than the world stander, and wheat seed production needs to improve. The wheat productivity was low because a lack of management methods, such as choosing a good cultivar that is suitable for the area cultivated, fertilization system, that commonly reduced wheat production. Therefore, researchers constantly resort to finding a new way through which the productivity of this crop can be raised. One of those ways is the interest in nutrition or organic fertilization by adding it to the soil or spraying it on the leaves, which has no harmful effect on the environment.

Using organic humic acid, which is a material humic and have an effective role in improving the physical properties of the soil and through their interaction with soil minerals and also improving the absorption capacity of nutrients, plays an important role in improving plant

growth through its effective role in plant nutrition, increasing cell division, increasing the effectiveness of enzymes and developing the root system. This reflected in an increasing in plant resistance to diseases, plant growth and production, improvement of plant quality, and a source of plant nutrients, especially nitrogen (Babar, *et al.*, 2022). Many studies tried to find the impact of humic acid on wheat growth, development, and yield. Most of those studies were used the cultivars that were not plant in Salahuddin governor, Iraq, or not in gypsum soil, which can make different.

In Egypt, (Attia and Ahmed, 2016) showed the effect of adding different levels of humic acid reducing the number of days from planting to flowering, the number of tillers per plant, plant height, and 1000 grains weight. (Anis and Zaki, 2017) obtained statistical differences between some wheat varieties, which used in their study, in time from planting to flowering, plant height, flag leaf area, 1000 grains weight, grain yield. (Hashem, 2018) founded that some levels of humic acid impacted wheat yield in general, as well as number of tillers, flag leaf area, and plant height. (Anis and Al-Majma'i, 2020) explained the advantage of using a wheat cultivar, Adanah, to improve plant height, 1000 grain weight, individual plant yield, biological yield, harvest index; however, using Rasheed and Jehaan cultivars showed increasing in the number of plant spikes per plant and number of seed in spike.

Even there were a lot of studies have done, there was no recommendation for using humic acid on wheat (Abdul Majeed, 2020), (Asaad and Anis, 2020). Therefore, this study aimed to identify the response of some wheat varieties to different levels of humic acid and to determine the best level of humic acid and the interaction between them under gypsum soil conditions.

MATERIAL AND METHODS

A field experiment was carried out during the season 2022-2023, The varieties were planted on 11/25/2022 and the harvest date was 5/15/2023 at the Field Crops Research Station (FCRS), located at Agriculture College, Tikrit University in a gypsum soil. The chemical and physical soil characteristics are listed in table 2. Soil was tallaged, leveled, and all other soil managements applied before planting. By using three levels of humic acid, 0, 20, and 40 $kg.h^{-1}$, and fifteen cultivars of wheat, Sham 6, Sham 8, Eba 95, Eba 99, Tammuz 2, Tammuz 3, Karada, AlEzz, Maxibac, Abu Ghraib 3, Al-Fateh, Intisar, Latifa, Bohoath 22 and Rashid experiment was applied using a Randomized Complete Block Design (RCBD), Split-plot. Three replicates were used, each replicate containing 45 experimental units. Humic acid levels were in the main plots, and cultivars that showed in table 1 were in the secondary plots. Each replication was two rows with length 3m for each. The density between the two rows was 0.3 m. Seeds, 16 gm for each row, after fertilizing the soil by using P_2O_5, 200 $kg.h^{-1}$, and urea, 200 $kg.h^{-1}$. The second amount of urea, 200 $ka.h^{-1}$, was added when plants were started making tillers. The number of days to expel the spikes was calculated from planting to the day that 50% of spikes appeared. Plant height was measured when plant reached the physiological maturity by taking the distance from soil serves to the top of plant. Flag leaf area was measured by taking 10 plant randomly using Hunt law (Hunt, 1987). Plants were harvested when reached the physiological maturity, and the number of active tillers, spikes per plant, and 1000 grain weight were founded. Total yield was calculated by taking the yield for 1 m^2 and converted to be in $kg.h^{-1}$.

Table 1. List of wheat cultivars and their sources

No.	Cultivars	Sources
1	Sham 6	PLe – RuFT Gtos –RheL(M12904)–IM –SM -14-OSK-GAP
2	Sham 8	ICARDA (Mosul General Authority for Agricultural Research)
3	Eba 95	ICARDA (Eba Research Center)
4	Eba 99	Ures/Rows/3/Jup/B/S//ures
5	Tammuz 2	Using irradiation on saberbeck with mexibac, fast neutrons
6	Tammuz 3	Using irradiation on saberbeck, maxibac, and, abu Ghraib 3, fast neutrons
7	Karada	Local cultivar
8	AlEzz	Using irradiation on saberbeck, nijah, maxibak, kama rays
9	Maxibac	An old cultivar that entered Iraq 1965
10	AbuGhraib	X Inia12 x Mexico24 Ajeeba
11	Al-Fateh	XCI_82… X
12	Intisar	Using irradiation on the third generation isolate of the hybrid Saberbeck x Australian Lajn in the third generation with a 10 krad gamma ray
13	Latifa	Crossbreeding of the Australian strain ARAS * S-cks / MCAS
14	Bohoath 22	ICARDA (Baghdad General Authority for Agricultural Research)
15	Rashid	Using irradiates on pure maxibac strains with a gamma of 10 k.

Table 2. Some of physical and chemical characteristics of experiment soil.

No.	Characteristics	Value
1	pH	7.44
2	EC	3.97 DC semince.m^{-1}
3	N	26.14 mg.kg.m^{-1}
4	P	7.45 mg.kg.m^{-1}
5	K	26.9 mg.kg.m^{-1}
6	Organic Matters	7.1 gm.kg^{-1}
7	Gypsum	150 gm.kg^{-1}
8	Sand	577gm.kg^{-1}
9	Clay	201 gm.kg^{-1}
10	Soil Structure	Sandy silty soil

RESULTS AND DISSCUSION

The results of analysis of variance that showed in table 3 indicated a significant variation among humic acid level for all traits, but the number of days from planting to spiking. Also, the cultivars and the interaction, humic acid x cultivars, showed a significant different in table 3. The explanation of that variation might be due the variation of the cultivars' sources. For all traits, the variations might be due to the fact that these varieties exhibited different behavior from one level of humic acid to another. Those result was consistent with the results of (Attia and Ahmed,2016), (Hashem, 2018), (Asaad and Anis ,2021).

Table 3. The source of variation analysis for three humic acid levels and fifteen wheat cultivars planted in a gypsum soil. Degree of freedom, (df) Day from planting to appear spike (DPS), flag leaf area (FLA), plant height (PH), active tillers (AT), seeds number per spike (SNS), 1000 grain weight (GW), and yield (Y)

Source of variation	Df	DPS	FLA	PH	AT	SNS	GW	Y
Replications	2	1.57	0.70	33.34	306.55	5.20	3.66	0.05
Humic acid levels	2	0.27	106.9**	345.0**	540.2**	298.9**	55.88**	12.36**
Error (a)	4	3.49	3.32	4.06	10.60	0.64	1.93	0.002
Cultivars	14	35.68**	56.85**	568.2**	3530.**	94.75**	68.40**	2.87**
Humic acid x Cultivars	28	14.45**	29.78**	23.67**	148.9**	38.41**	30.06**	1.11**
Error (b)	84	2.63	1.72	8.21	14.93	2.46	1.24	0.0008

*significant level when $p < 0.05$, ** significant level when $p < 0.01$, **significant level when $p < 0.001$

Humic acid levels impact the wheat trait presented in table 4. Although the humic acid levels were not significantly affected in the number of days from planting to appear spikes, there was a high average to the trait when the level was 40 $kg.h^{-1}$, which was 107 days. Increasing the level of humic acid affected significantly the flag leaf area. Where the humic acid level of 40 $kg.h^{-1}$ gave the highest average leaf area of 48.23 cm^2 compared to the control treatment of 0 $kg.h^{-1}$, with an increase rate of 5.05%. Humic acid positively affected plant growth by increasing the permeability of cell membranes, excite the enzymatic reactions, improve cell division, cell elongation, increasing plant enzyme production, and excite vitamins inside the cells. Also, these activities increased the vegetative growth of the plant (Sami et al., 2013), (Hashem, 2018). The 40 $kg.h^{-1}$ humic acid helped increasing plant heigh significantly, 103.51 cm, Compared to the control treatment 0 $kg.h^{-1}$, an increase of 5.09%. Humic acid improved plant growth and development. Therefore, high level of humic acid could make plant higher. Where the humic acid level of 40 $kg.h^{-1}$ gave the highest average number of tillers of 320.83 m^{-2} compared to the control treatment of 0 $kg.h^{-1}$, with an increase rate of 1.99%. Where the humic acid level of 40 $kg.h^{-1}$ gave the highest average number of grains per spike 57.67 compared to the control treatment of 0 $kg.h^{-1}$, with an increase rate of 8.85%. While the humic acid level of 40 $kg.h^{-1}$ gave the highest average weight of 1000 grains 35g compared to the control treatment of 0 $kg.h^{-1}$, with an increase rate of 6.67%. The humic acid level of 40 $kg.h^{-1}$ gave the highest average total yield of 6.47 $ton.h^{-1}$ compared to the control treatment of 0 $kg.h^{-1}$, with an increase rate of 18.5%. Increasing the amount of humic acid that available to plants was increased the vegetative growth and development of wheat. That led to Increase processing of carbohydrates in the leaves and transferred all plants parts, which led to an increasing in the yield (Anwar et al, 2016), (Jamal et al, 2018) (Darmash et al, 2019).

Table 4. The averages the impact of humic acid on the wheat traits.

Wheat traits	Levels of humic acid			LSD
	0 kg.h^{-1}	20 kg.h^{-1}	40 kg.h^{-1}	
Days from planting to spike appear, days	107.56	107.40	107.47	n.s.
Flag leaf area, cm^2	45.91	45.31	48.23	1.07
Plant height, cm	98.49	98.98	103.51	1.18
The number of active tillers, m^2	314.54	320.21	320.83	1.91
grains per spike, number	52.98	53.47	57.67	0.47
1000 grains weight, gm	32.81	33.53	35	0.81
Yield, ton.h^{-1}	5.46	5.73	6.47	0.03

The results indicated a significant variation among cultivars for all traits. Although Bohoath 22 was not significant different with Tammuz 2, AlEzz, Maxibac, Abu Ghraib 3, Latifa for the period to reach spike appearing, Bohoath 22 had a shortest significant period to reach spike appearing,104.89 d, compared with the other cultivars in table 5, however, cultivar Sham 8 delated to reach spike by 111d. Rasheed cultivar had a higher flag leaf area compared with other cultivars, and it was 50.32 cm^2 while Eba 95 had a lowest flag leaf area, and it reached 42.69 cm^2. Intisar cultivar was significantly higher in plant height compared with the other cultivars, and it reached 120.89 cm. on the other hand, Eba 99 cultivar was shortest, and it gave 90.33 cm. There were several factors that affected making the plant height different among the cultivars including the competition among the cultivars for light, nutrients, and water. the level of their conversion into building materials, hormones activity, photosynthesis products. All that was reflected in the growth and elongation of stem cells instead of accumulating in parts of the plant, which could be increasing plant height. In terms of the number of active tillers, Al-Fateh cultivar produced a higher number of active tillers compared with the other cultivars, and it was 351.08 no.m^{-2}. On the other hand, the cultivar Sham 8 had the lowest number of active tillers, and it was 283.56 no.m^{-2} Increasing the number of active tillers might be due to the number of days that available for vegetative growth, which was allowed to produce more tillers compared with the other cultivars (Attia and Ahmed, 2016) and (Fazily and Habibi 2019). Tammuz 2 cultivar was significantly higher by the number of grains per spike, and it was 59.67 no. spike^{-1}. At the same time, while Sham 8 cultivar had the lowest number of grains per spike, and it was 29.44 no. spike^{-1}.

The number of grains per spike is directly proportional to the vitality of pollen and the egg, on the other hand, it is due to the strength of the source in absorbing light and converting the metabolites to the estuaries, including the reproductive parts.

Table 5. The variations among wheat cultivars depend on; yield, ton.h^{-1} (Y); weight of 1000 grain, g (1000 G); Number of grains on spike, no. (GN); number of active tillers, (AT); plant height, (PH); flag leaf area, (FLA); number of days from planting to flowering, (NDPF).

Cultivars	Y	1000 G	GN	AT	PH	FLA	NDPF
Sham 8	4.53	32.22	49.44	283.56	90.89	45.93	111.00
Eba 99	6.95	36.67	58.78	323.49	90.33	45.71	108.67
Tammuz 2	6.72	35.06	59.67	330.64	92.22	48.25	105.89
Karada	5.87	32.11	53.56	335.26	98.00	45.32	109.56
AlEzz	6.18	40.50	50.22	296.78	109.11	46.86	105.22
Eba 95	5.85	33.61	55.67	318.42	101.00	42.69	108.89
Maxibac	5.81	30.68	54.89	333.11	98.11	43.08	105.67
Sham 6	5.92	33.83	53.44	329.83	97.11	48.05	106.89
AbuGhraib	6.01	36.61	54.56	300.27	108.56	43.19	105.56
Al-Fateh	6.23	30.06	57.56	351.08	97.44	45.67	108.11
Intisar	5.70	33.89	55.56	302.31	120.89	49.40	106.78
Latifa	6.05	35.11	59.11	313.78	99.11	47.02	105.67
Tammuz 3	5.67	33.83	55.44	292.59	103.22	46.63	109.67
Bohoath 22	5.42	31.61	50.11	344.95	102.67	45.17	104.89
Rashid	5.36	30.94	52.56	322.82	96.22	50.32	109.67
LSD values	**0.03**	**1.04**	**1.47**	**3.63**	**2.69**	**1.23**	**1.52**

In addition, the genetic factors with environmental factors are influence plant pollination. (Anis and Zaki, 2017). AlEzz cultivar exhibited the highest average of the weight of 1000 grain and it was 40.50 g, with a significant difference compared with the other cultivars; however, Al-Fateh cultivar showed the lowest average of the weight of 1000 grain, and it reached 30.06 g. Therefore, the reason could be due to the strength of the source in the plant production that transferred by cell metabolites to the sink better than other cultivars (Nwry et al.2021). The Eba 99 cultivar had a significant difference by having a higher yield compared to the other cultivars with an average of 6.99 ton.h^{-1} while the Sham 8 cultivar had the lowest average of yield, and it was 2.17 tons.h^{-1}. Increasing plants yield is nothing but a reflection of its superiority in the yield components such as the number of spike grains, spike length, grain weight. Therefore, increasing the efficiency of photosynthesis reflected the final outcome, and it led to an increase in the yield (Salah H. Jumaa 2021).

There was a significant difference in humic acid levels and cultivars interactions exhibited in table 6. The interaction 0 kg.h^{-1} x Intisar was significantly shortest period from planting to spike appearance, 102.33 d, compared with the other interactions except the interactions the 0 kg.h^{-1} x (AlEzz, AbuGhraib, and Bohoath 22), 20 kg.h^{-1} x (Tammuz 2 and AbuGhraib), and 40 kg.h^{-1} x (AlEzz and Bohoath 22). On the other hand, the interaction 40. Kg.h^{-1} x Sham 8 had a longest period from planting to spike appearance, and it was 112.33 d. The interaction 40 kg.h^{-1} x Latifa produced a significant higher flag leaf area, 54.43 cm^2, compared with the other interactions except the interaction 40 kg.h^{-1} x Rashid. The 0 kg.h^{-1} x Maxibac had s significant less flag leaf area, which was 38.56 cm^2,With an increase of 41.51%. The interaction 40 kg. h^{-1} x Intisar exhibited a significant plant height compared with the other interactions, 126.33 cm, while the inter action 0 kg. h^{-1} x Eba 99 had a significant short plant height, 84.67 cm With an increase of 49.2%. The variations in the plants' genetic structure and differences in the humic acid levels have clearly contributed to the variation among the interactions for plant height.

Table 6. The interaction between humic acid and cultivars effect on wheat traits. Yield, ton.h^{-1} (Y); weight of 1000 grain, g (1000 G); Number of grains on spike, no. (GN); number of active tillers, (AT); plant height, (PH); flag leaf area, (FLA); number of days from planting to flowering, (NDPF).

Humic acid levels	Cultivars	Y	1000 G	GN	AT	PH	FLA	NDPF
	Sham 8	3.90	30.67	47.00	270.05	88.33	44.56	111.67
	Eba 99	6.36	33.00	56.33	320.43	84.67	43.64	108.67
	Tammuz 2	5.74	33.17	57.67	324.73	89.67	47.99	108.67
	Karada	5.72	32.00	52.67	332.20	94.67	44.31	110.67
	AlEzz	5.33	34.83	50.33	293.62	107.00	49.38	104.33
	Eba 95	4.97	31.50	54.67	302.80	98.00	41.45	107.00
	Maxibac	5.33	30.37	50.00	336.33	95.67	38.56	106.33
0 kg.h^{-1}	Sham 6	5.51	33.50	52.33	326.45	95.67	49.66	106.00
	AbuGhraib	5.76	36.17	53.33	293.62	106.67	42.32	104.33
	Al-Fateh	5.92	29.50	53.67	345.02	96.33	41.27	107.00
	Intisar	5.41	35.33	50.67	305.27	119.00	46.91	102.33
	Latifa	5.71	35.00	59.00	324.67	99.33	41.30	105.67
	Tammuz 3	5.21	33.83	54.00	278.45	101.00	49.72	111.67
	Bohoath 22	5.49	31.50	51.33	342.73	104.00	46.54	104.67
	Rashid	5.20	31.83	50.67	321.77	97.33	48.37	114.33
	Sham 8	5.18	32.00	48.00	284.93	89.00	42.87	109.00
	Eba 99	6.63	36.00	54.67	325.82	88.67	45.28	109.00
	Tammuz 2	6.00	30.33	56.00	335.18	91.33	47.23	103.33
	Karada	5.70	30.67	56.00	334.42	94.67	48.67	110.00
	AlEzz	6.45	44.33	49.00	295.83	108.00	46.76	108.33
	Eba 95	6.31	36.33	53.33	336.67	102.33	44.02	110.67
	Maxibac	5.71	29.00	56.67	328.65	97.67	43.26	105.33
20 kg.h^{-1}	Sham 6	5.66	30.00	54.00	331.83	96.67	43.53	108.33
	AbuGhraib	5.39	32.67	54.33	301.53	110.67	42.66	104.67
	Al-Fateh	5.75	35.00	55.67	353.17	96.33	48.01	108.67
	Intisar	6.03	35.33	57.00	303.05	117.33	51.97	108.00
	Latifa	5.66	35.00	56.67	307.23	97.33	45.33	106.33
	Tammuz 3	5.75	35.67	53.33	298.08	96.67	48.17	107.33
	Bohoath 22	4.62	31.67	45.00	343.37	102.33	40.51	105.33
	Rashid	4.06	29.00	45.00	321.77	95.67	49.11	106.67
	Sham 8	4.52	34.00	55.33	295.70	95.33	50.37	112.33
	Eba 99	7.85	41.00	65.33	324.23	97.67	48.22	108.33
	Tammuz 2	8.42	41.67	65.33	332.02	95.67	49.52	105.67
	Karada	6.17	33.67	52.00	339.17	104.67	42.97	108.00
	AlEzz	6.75	44.33	51.33	300.90	112.33	44.43	103.00
	Eba 95	6.28	33.00	59.00	315.78	102.67	42.60	109.00
	Maxibac	6.38	32.67	58.00	334.35	101.00	47.43	105.33
40 kg.h^{-1}	Sham 6	6.58	38.00	54.00	331.20	99.00	50.97	106.33
	AbuGhraib	6.87	41.00	56.00	305.65	108.33	44.59	107.67
	Al-Fateh	7.03	25.67	63.33	354.83	99.67	49.30	108.67
	Intisar	5.66	31.00	59.00	298.62	126.33	49.30	110.00
	Latifa	6.77	35.33	61.67	309.45	100.67	54.43	105.00
	Tammuz 3	6.05	32.00	59.00	301.25	112.00	50.50	110.00
	Bohoath 22	6.15	31.67	54.00	348.75	101.67	48.47	104.67
	Rashid	6.82	32.00	62.00	324.93	95.67	53.59	108.00
LSD values		0.05	1.81	2.55	6.28	50.37	2.13	2.64

The active tillers trait impacted by the interactions between humic acid level and wheat cultivars. (Hashim, 2018). The highest active tillers observed at the interaction 40 kg. h^{-1} x Al-Fateh 354.83 number of active tillers m^{-2} while the interaction 0 kg. h^{-1} x Sham8 270.05 number of active tillers m^{-2} With an increase of 41.51%had a significantly fewer active tiller compared with the other interactions. That explained that genetic affected active tillers. Also, the period of seed growth and development was longer than the vegetative growth stages, which can contribute to providing sufficient time for the growth of the largest number of active tillers (Abdul Majeed,2020). For the

grain number per spike, the interaction 40 kg. h^{-1} x (Eba 99, Tamuz 2, and Al-Fateh) had a significant higher grain number per spike, which was near to 65.33 $spike^{-1}$ with an increase of 41.4%. however, the interaction 20 kg. h^{-1} x Rashid and Bohoath 22 had lower number of grains per spike, 45 no. $spike^{-1}$. The main reason for the variations was reached a significant level when the humic acid levels varied. For the 1000 grains weight, the interactions 40 kg. h^{-1} x AlEzz had a significant highest average, 44.33 g, compared with the other interactions while the interaction 0 kg. h^{-1} x (Mexibac and Rashid) was the lowest weight, 29.00 g, compared with the other interactions with an increase of 47.7%. The cultivars ability to absorb the nutrients and then export them to the plant sinks, and that was clearly impacted the grain weight (Asad and Anis, 2020). Wheat yield affected significantly by the interaction between humic acid levels and cultivar. The interaction 40 kg. h^{-1} x Tammuz 2 exceeded higher yield, 8.42 ton. h^{-1}. compared with the other interactions while the yield decreased to be 3.90 ton. h^{-1} when the interaction 0 kg. h^{-1} x Sham 8 happened. with an increase of 115.3%, The differential in yield related to three reasons. First is the genetic variations, which was applied in this experiment by using different cultivars. Second is the humic acid levels, which improved the wheat growth and development. Third is the interaction between the cultivars and humic acid levels (Attia and Ahmed,2016).

CONCLUSIONS

The use of 40 kg.h of humic acid improved the productivity of some of the studied varieties, and varieties such as Tamoz 2 and Eba 99 with humic acid showed significant superiority in gypsum soil compared to other varieties.

CONCLUSION

Therefore, the recommendation of the current study is to use these two varieties Tamoz 2 and Eba 99 in gypsum soil with a higher level of humic acid. The important conclusions and consequences of the investigation should be succinctly explained in the Conclusions section, emphasizing their significance.

CONFLICT OF INTEREST

We, the authors, hereby acknowledge that this manuscript has not been published in any previous journal, with our sincere.

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