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Evaluation of the growth and yield response of wheat varieties (*Triticum aestivum* L.) to humic acid

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Abstract

In order to increase productivity and improve growth and yield characteristics of wheat, the study was conducted during the autumn season of 2024–2025 with the aim of evaluating the growth and yield response of wheat varieties (Triticum aestivum L.) to the effect of humic acid and grown under semi-arid conditions in Diyala Governorate. The experiment was implemented according to the design of the Randomized Complete Blocks (R.C.B.D) and the factorial experiment system, with two factors: the first factor was three varieties of wheat crop (Baghdad, Buhouth3, Al-Rasheed) and the second factor was spraying with humic acid at two levels (without adding H_0, adding H_1 2ml.L^{-1}) with three replications. The results obtained from the study showed the superiority of the Al-Rashid variety in most of the studied traits, which are plant height 76.33 cm, number of effective branches per plant 5.58, spike length 13.25 cm, number of grains per spike 58.83, weight of 1000 grains 44.33 g, yield per plant 8.15 g and biological yield 31.08 g. while the superiority of the Buhouth3 variety in the trait of flag leaf area 24.88 cm^2 and harvest index 32.49%. As for the second factor, which is spraying with humic acid, the H_1 addition treatment was superior for all studied traits, which are plant height cm, flag leaf area cm^2, number of effective branches. Plant^{-1}, spike length cm, number of grains. Spike^{-1}, weight of 1000 grains g, yield per plant g, biological yield g and harvest index %, which reached 76.44 cm, 28.11 cm^2, 4.22, 12.17 cm, 46.33, 43.88 g, 6.05 g, 21.55 g and 28.75% respectively. The interaction between the Rashid variety and humic acid H_1 spraying resulted in a maximum plant height of 82.00 cm, 6.00 effective tillers per plant, a spike length of 15.33 cm, 60.00 grains per spike, a 1000-grain weight of 49.32 g, a yield per plant of 9.51 g, and a biological yield of 32.67 g. The Buhouth3 variety and H_1 humic acid spraying also showed in a larger flag leaf area of 30.00 cm^2 and a harvest index of 37.07%. These results demonstrate the importance of appropriate variety selection as a key factor contributing significantly to improved wheat growth and yield when treated with humic acid.

Keywords: Varieties, wheat, growth characteristics. Yield and its components. Humic acid.

I. Introduction

Wheat (*Triticum aestivum* L.) is one of the most important strategic cereal crops and the most produced and consumed in the world (Zahid et al., 2003). A third of the world's population depends on this crop for their diet. Despite the variety of crops in terms of quantity and type, wheat remains at the top of the main crops for global food because its grains contain gluten protein, which distinguishes it from other grains. Gluten forms the basic structure of bread, making it extremely important in human nutrition (Basanbel, 2013). Humans need grains for about 75% of their food, and wheat is the most important of these crops, so it comes first in terms of cultivated area and production (Buskuk, 1998). Its grains are also the main source of energy that humans need, as they enter directly into their food due to their high nutritional value, as they contain a high percentage of carbohydrates, proteins, and starch. This has made it play a major role in international trade and the balance of the global economy (Al-Nuaimi, 2011).

Wheat production in Iraq faces numerous problems that have led to a significant decline in its quality and reduced its yield per unit area compared to global production. Most of these problems are related to the variety, crop management practices, soil issues, and drought. This prevents the crop from fully utilizing its physiological and genetic potential (Ministry of Agriculture, 2017). In recent years, attention has focused on developing new wheat varieties adapted to environmental conditions and with high productivity based on

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their genetic structure, as well as following sound scientific farming methods and factors for successful cultivation (Jassim et al. 2024) , (Hassan et al., 2009). There are many factors that contribute significantly to increasing plant productivity, including a good variety adapted to the region, which greatly contributes to increasing crop yield. Wheat varieties vary in their productivity, which is normal due to their genetic nature. Therefore, introducing new, high-yielding varieties affects production, improves quality, and reduces costs. Furthermore, selecting varieties suitable for the region's conditions helps increase production and improve quality (Al-Abbar, 2021 and Muhammad, 2021).

Despite the efficiency of mineral fertilizers and their effective role in increasing agricultural production and improving crop quality, they remain economically costly and may cause environmental damage. Therefore, needing to reduce their use by turning towards nutritional supplements that contribute to reducing their use. This approach includes the use of natural alternatives such as organic fertilizers like humic acid, which show effectiveness in improving the physical and chemical properties of the soil and enhancing its fertility. They also contribute to increasing the availability of some nutrients to the plant. These compounds lead to positive effects on plant growth by increasing the permeability of cell membranes, stimulating enzymatic reactions, improving cell division, and enhancing the production of plant enzymes (Nardi et al. 2021). Recent studies have shown increasing interest in the use of humic acid, which contributes to chelation, thus enhancing the availability of nutrients for plant uptake. Furthermore, it promotes the presence of microorganisms in the soil, which in turn increases nutrient availability and supports plant growth and crop yield (Channab et al., 2023; Eshwar et al., 2017). Humic acid is primarily composed of carbon, hydrogen, nitrogen, oxygen, and sulfur arranged in long, branched carbon chains. It also contains significant amounts of nutrients, plant hormones, and amino acids, contributing to improved soil fertility and enhanced plant growth (Alfarisy et al., 2021),(Bhatt and Singh, 2022). Humic acid plays a main role in improving the plant's ability to absorb nutrients, and this contributes to stimulating the activity of hormones such as auxin, which directly affects seed germination, vegetative growth, and increased root elongation. These acids help to reduce the effects of salt stress, drought, and high temperatures on plants. They also directly affect the permeability of cell membranes of roots and leaves, which facilitates the process of nutrient absorption (Chen et al., 2022).

Given the increasing consumption of wheat as a source of energy and protein and its nutritional importance, the idea for this study emerged, which aims to evaluate wheat varieties and select the best ones at different growth stages for the addition of humic acid, and the extent of its effect on the growth characteristics of the crop and its components.

II. Materials and Methods

The experiment was conducted in the researcher's field in Baladruz District, Diyala Governorate, during the first week of November of the 2024-2025 winter season (Jassim et al. 2024), to determine the performance of growth and yield characteristics of wheat under the influence of humic acid spraying. The study included two factors: the first factor was the wheat varieties (Baghdad, Buhouth3, and Al-Rasheed), designated V_1, V_2, and V_3 respectively; and the second factor was humic acid spraying (without the addition of H_0, with the addition of H_1 2ml/L^{-1}). Humic acid was added at a rate of three applications distributed throughout the growing season. The experiment was conducted using a completely randomized block design (RCBD) with three replicates, each containing six treatments, resulting in a total of 18 experimental units. Each experimental unit measured 1m x 2m, with a 1m spacing between units within each replicate. Each experimental unit comprised 10 rows, with a planting distance of 10 cm and a planting depth of 1-1.5 cm. Soil preparation, irrigation, and fertilization were carried out. Nitrogen fertilizer in the form of urea (46% nitrogen) was applied at a rate of 180 kg/ha in two applications: the first at planting and the second 60 days later. Triple superphosphate (P_2O_5 46%) was used as the phosphorus source at a rate of 100 kg/ha, applied in a single application during soil preparation (Al-Abadi, 2011). The study included the following characteristics:

Plant hight cm: According to the height measured from the ground surface to the top of the spike (excluding the awns) of ten randomly selected plants.

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Flage leaf area cm^2 : The flag leaf area of ten main shoot plants was calculated at full flowering according to the following equation: Flag leaf area of the shoot = Flag leaf length of main shoot × Leaf width at midpoint × 0.95 According to the equation (Thomas, 1975).

Number of active tillers per.plant $^{-1}$: The number of tillers in each plant that bears spikes was counted as an average of ten plants that were randomly selected.
Spike length cm : From the base of the ear to the tip of the ear, excluding the chaff, measured in centimeters for ten ears taken randomly from ten randomly selected plants.
Number of grains per.spike^{-1} : Estimate the number of grains in the ear of corn for each plant by counting the number of grains in the ear of corn for ten plants after separating them by hand.
grains weight 1000 g : 1000 grains were weighed, taken randomly from the seed yield of each experimental unit.
Grain yield per plant g : Determine the grain yield in grams of dry weight of grain produced from each plant.
Biological yield g: Plant-1 The average yield of the plant (ears + straw) is represented as the average for ten plants that were randomly selected.
Harvest index% : According to the harvest guide for each plant by Anderson and Garling (2000), using the following equation: Harvest index= (Grain yield per plant (g) / Biological yield per plant(g)) × 100 .
Statistical analysis was performed for all studied traits using the Least Significant Difference (L.S.D) test at a probability level of 0.05 to compare the arithmetic means (Al-Sahouki & Wahib, 1990). The GenStat statistical software was used for the analysis. Soil samples were taken from the experimental soil at a depth of (0-30) cm, and some of their physical and chemical properties were measured as shown in Table (1). The soil was analyzed in the laboratory of the Department of Soil Science and Water Resources, College of Agriculture, University of Diyala, where the physical and chemical properties of the soil were analyzed using the methods described by (Page et al. 1982).

Table 1. shows the physical and chemical properties of the experimental soil.

Characteristics	**Unit**	**Value**
Sand	%	25.0
Slime	%	31.5
Clay	%	43.5
Cation exchange capacity	$cmol.kg^{-1}$	15.40
Electrical conduction EC	$(ds.m^{-1)}$	7.3
Soil PH	-	7.9
Organic matter	%	0.40
Gypsum	$g.kg^{-1}$	0.142
Nitrogen	$mlg.kg^{-1}$	30.5
Phosphors	$mlg.kg^{-1}$	30.2
Potassium	$mlg.kg^{-1}$	130.2

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III. Results and discussion

1.Plant hight cm

Table 2 shows significant differences in plant height (cm) among the varieties. The highest plant height was recorded for variety V_3, reaching 76.33 cm. This height gradually decreased in varieties V_1 and V_2, respectively, reaching a minimum average of 67.20 cm in V_2. Shorter plant height is a desirable trait if it does not negatively impact the variety's energy and productivity. It is known that shorter plants experience less competition among themselves compared to taller plants, resulting in higher harvest coefficients due to reduced internal competition. On the other hand, tall plants may have a better ability to tolerate drought due to the depth of their roots, making them more drought-tolerant than short plants. This is what (Al-Sahouki,2004) indicated, that the variation in the varieties used reflects the difference in the nature of their growth in terms of their growth rate and the length of the internodes. That the variation in plant height may be due to the variation in the length of the internodes. Which may result in the leaves being close together, That may negatively affect the distribution of light energy between the different vegetative parts of the plant and as a result in a decrease in the photosynthetic efficiency of the lower leaves and a decline in the efficiency of water use. This is what Hetherinjton (2001) indicated, and this is consistent with (Al-Nuaimi 2006), (Al-Jabouri 2014), (Al-Bayati and Al-Namrawi 2023). Table 2 shows that humic acid has a significant effect on plant height. The H_1 level (2 ml L^{-1}) achieved the highest average height (76.44 cm) compared to the control level (0 ml L^{-1}), which recorded the lowest average height (66.78 cm). This superiority may be attributed to the positive effect of humic acid on increasing plant height, enhancing in cell expansion and root branching. and consequently, increased nutrient absorption from the soil. Humic acid also plays an important role in physiological processes by stimulating enzyme activity and its role in cell division and elongation, leading to increased plant height (Chen et al., 2022). Regarding the interaction between varieties and humic acid, variety V_3 and the H_1 humic acid level presented the highest average height 82.00 cm, while variety V_2 and the H_0 humic acid level stated the lowest average height 63.67 cm.

Table 2. the average values of varieties, humic acid, and their interaction in plant height (cm).

Varieties	Humic acid		Means
	H_1	H_0	
V_1	76.67	66.00	71.33
V_2	70.67	63.67	67.20
V_3	82.00	70.67	76.33
Means	76.44	66.78	
L.S.D 0.05	Varieties 1.97	Humic acid 1.61	Interaction 2.79

2.Flage leaf area cm^2;

The results in Table 3 show significant differences between the averages of the varieties in the flag leaf area (cm^2). It is noted that the largest flag leaf area was for the V_2 variety, reaching 24.88 cm^2, and the smallest flag leaf area was given by the V_1 variety, reaching 17.80 cm^2. The reason for the variation in the varieties in flag leaf area is due to their variation in genetic structures and the difference of these structures in the period from planting to 100% flowering, which includes the period of growth and expansion of the flag leaf. This result is consistent with (Jassim et al. 2024). Table 3 shows that humic acid has a significant effect on flag leaf area (cm^2), with level H_1 achieving the highest average of 28.11 cm^2 compared to the control level H_0, which recorded the lowest average of 16.66 cm^2. This superiority may be attributed to humic acid improving

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plant growth conditions by providing readily absorbable macro and micronutrients, thus promoting vegetative growth and increasing photosynthesis, which in turn contributes to expanding the flag leaf area and increasing its effectiveness (Sindhu et al., 2022). This result is consistent with (Al-Bayati and Al-Namrawi 2023). Table 2 indicates that variety V_2 and humic acid level H_1 achieved the highest overlap in flag leaf area at 30.00 cm², while variety V_1 and humic acid level H_0 showed the lowest overlap at 11.23 cm².

Table 3. average values of varieties, humic acid, and their interaction in the flag leaf area (cm²).

Varieties	Humic acid		Means
	H_1	H_0	
V_1	24.37	11.23	17.80
V_2	30.00	19.77	24.88
V_3	29.97	18.97	24.47
Means	28.11	16.66	
L.S.D 0.05	Varieties 1.50	Humic acid 1.23	Interaction 2.13

3.Number of active tillers per.plant $^{-1}$;

Table 4 shows significant differences in the average number of effective branches per.plant $^{-1}$, with variety V_3 giving the highest value of 5.58, while variety V_1 gave the lowest average of 2.66. The variation between varieties in this trait is due to differences in their genetic structure and also to their variation in the size of the green surface in the photosynthetic process, which may lead to an increase in the percentage of transformation of vegetative forms into fruiting ones (Knezevic et al., 2015 and Kobata et al., 2018). Table 4 shows that humic acid has a significant effect on the number of effective branches in the plant, with the H_1 level achieving the highest average of 4.22 compared to the H_0 level, which recorded the lowest average of 3.50. This superiority may be attributed to the fact that humic acid improves plant growth conditions by providing macro and micronutrients (Sindhu et al., 2022). The same table also indicates that the interaction between varieties and humic acid levels was significant, with variety V_3 and H_1 humic acid level showed the highest interaction value of 6.00, while variety V_1 and H_0 humic acid level showed the lowest interaction value of 2.33.

Table 4. average values of varieties, humic acid, and their interaction in the number of effective branches. Plant^{-1} .

Varieties	Humic acid		Means
	H_1	H_0	
V_1	3.00	2.33	2.66
V_2	3.66	3.00	3.33
V_3	6.00	5.16	5.58
Means	4.22	3.50	
L.S.D 0.05	Varieties 0.40	Humic acid 0.32	Interaction 0.56

4.Spike length cm;

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The most distinctive and obvious characteristic of wheat crop is spike length, as varieties differ in spike length, width, and shape among themselves. These variables can be used as key indicators in diagnosing and classifying different types. It is noted through the comparison of the averages of this characteristic in Table 5 that the highest value for the average spike length is for variety V_3, with an average of 13.25 cm, and the lowest value is given by variety V_1, with an average of 8.67 cm. The difference between varieties in this characteristic is due to their difference in genetic structure (Kobata et al., 2018). The results in the same table show that humic acid had a significant effect on spike length, with the H_1 level achieving the highest average length of 12.17 cm compared to the H0 level, which recorded the lowest average length of 9.61 cm. This superior spike length increase may be attributed to the positive effect of humic acid, which helps improve the efficiency of carbon metabolism by providing the plant with essential nutrients. This enhances the plant's ability to convert carbohydrates and organic products into different growth parts. It also facilitates the translocation of products from the plant (leaves and stem) to the plant (spikes), ultimately leading to increased spike length and plant productivity (Fanuel and Gfole, 2013). Regarding the interaction, the V_3 variety and the H_1 humic acid level showed the highest interaction at 15.33 cm, while the V_1 variety and the H_0 humic acid level showed the lowest interaction at 8.33 cm.

Table 5. average values of varieties, humic acid, and their interaction in the spike length (cm).

Varieties	Humic acid		Means
	H_1	H_0	
V_1	9.00	8.33	8.67
V_2	12.17	9.33	10.75
V_3	15.33	11.17	13.25
Means	12.17	9.61	
L.S.D 0.05	Varieties 1.08	Humic acid 0.82	Interaction 1.42

5.Number of grains per.spike^{-1} ;

Table 6 data showed a difference in the average number of grains per spike among the different varieties, with variety V_3 giving the highest average at 58.83 and variety V_1 giving the lowest average at 34.16. The reason for the difference in this characteristic among the wheat varieties included in the study is attributed to the variation in the number of spikes among the varieties. This result is consistent with (Al-Muhammadi, 2011, Al-Saadi and Al-Jubouri, 2016, and Al-Bayati and Al-Namrawi, 2023) that wheat varieties differ among themselves in the number of grains per.spike^{-1}. Table 6 showed that humic acid had a significant effect on the number of grains per.spike^{-1}. Level H_1 achieved the highest average of 46.33, compared to the control level H_0, which recorded the lowest average of 42.99. This superiority may be attributed to humic acid's role in lowering soil pH, thereby dissolving minerals, particularly potassium and other elements, and converting them into forms readily available for plant uptake. This promotes vegetative growth, increases dry matter accumulation, improves pollination and fertilization, reduces ovarian abortion, and increases the number of grains per row (Fanuel and Gole, 2013). The interaction between varieties and humic acid levels was also significant. Variety V_3 and H_1 humic acid level showed the highest interaction value of 60.00, while variety V_1 and H_0 humic acid level showed the lowest value of 32.66.

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Table 6. average values of varieties, humic acid, and their interaction in Number of grains per.spike[-1]

Varieties	Humic acid		Means
	H_1	H_0	
V_1	35.66	32.66	34.16
V_2	43.33	38.66	40.99
V_3	60.00	57.66	58.83
Means	46.33	42.99	
L.S.D 0.05	Varieties 2.60	Humic acid 2.12	Interaction 3.68

6.grains weight 1000 g ;

This characteristic is important in all crops, especially wheat, as it reflects grain fullness and maturity, providing a good indicator of grain yield. The thousand-grain weight is considered one of the most important technological indicators considered by national standards and is a key component of productivity, along with the number of grains per spike and the number of spikes per unit area. Both the number of grains and the thousand-grain weight are among the most important traits associated with improving production (Al-Jayashi et al., 2021). Table 7 showed significant differences in the thousand-grain weight due to variations in cultivars. Categorical V_3 produced the highest thousand-grain weight at 44.33 g, while Categorical V_1 produced the lowest average weight at 38.17 g. The variation between varieties in this trait may be due to differences in their genetic structure the length of the grain filling period, and other yield components, as well as the high efficiency of varieties in utilizing photosynthesis products and manufacturing a larger quantity of dry matter and harnessing it for flowers and grains, which led to an increase in the percentage of fertile flowers, and consequently an increase in the number of grains, their size, and their degree of filling (Knezevic et al., 2015 and Kobata et al., 2018). The results in the same table showed that humic acid had a significant effect on the weight of 1000 grains. Level H_1 achieved the highest average weight of 43.88 g, compared to the control level H_0, which recorded the lowest average weight of 38.41 g. The increased in the weight of 1000 grains may be attributed to the fact that humic acid promotes better plant growth. It provides essential nutrients to the plant and increases photosynthesis, which affects grain formation and development, making the grains fuller and therefore heavier (Chen et al., 2022). The interaction between variety and humic acid levels had a significant effect. Variety V_3 and H_1 humic acid level showed the highest interaction value of 49.32 g, while variety V_1 and H_0 humic acid level showed the lowest interaction value of 36.68 g.

Table 7.average values of varieties, humic acid, and their interaction in the grains weight 1000 (g).

Varieties	Humic acid		Means
	H_1	H_0	
V_1	39.67	36.68	38.17
V_2	42.65	39.22	40.93
V_3	49.32	39.34	44.33
Means	43.88	38.41	
L.S.D 0.05	Varieties 2.36	Humic acid 1.92	Interaction 3.33

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7.Grain yield per plant g;

Grain yield in wheat is determined by several components: the number of spikes, the number of grains per spike, and grain weight. Each of these three components is influenced by genetic and environmental factors and their interactions (Knezevic et al., 2015). The data in Table 8 indicate a significant effect of variety on Grain yield per plant. Variety V_3 yielded the highest average of 8.15 g, while variety V_1 yielded the lowest average of 3.41 g. This is attributed to the superiority of variety V_3 in most yield components and its adaptation to environmental factors (Tables 4, 6, and 7). This finding is consistent with the results of Al-Tamimi (2019), Meleha et al. (2020), and Jassim et al. (2024), who noted the differences in grain yield among wheat varieties. The results in the table showed that humic acid significantly affected the Grain yield per plant. Level H_1 achieved the highest average yield of 6.05 g, compared to the control level H_0, which recorded the lowest average yield of 4.32 g. Humic acid contributes to improving soil fertility and increasing the activity of microorganisms, thus enhancing the continuous availability of nutrients to the plant. This leads to improved vegetative growth by increasing plant height, leaf area, and the number of branches (Tables 2, 3, and 4). This, in turn, increases the plant's ability to absorb light and stimulates photosynthesis. Consequently, the number of spikes per plant, the number of grains per spike, and the 1000-grain weight increase (Tables 4, 6, and 7). Therefore, humic acid contributes to increasing the yield of wheat per plant by stimulating plant growth and improving grain formation (Chen et al., 2022). Table 8 shows that the interaction between varieties and acid levels was also significant. Variety V_3 and humic acid level H_1 achieved the highest value of 9.51 g, while variety V_1 and interaction level H_0 achieved the lowest value of 3.00 g.

Table 8. average values of varieties, humic acid, and their interaction in the Grain yield per plant (g).

Varieties	Humic acid		Means
	H_1	H_0	
V_1	3.82	3.00	3.41
V_2	4.82	3.16	3.99
V_3	9.51	6.80	8.15
Means	6.05	4.32	
L.S.D 0.05	Varieties 1.53	Humic acid 1.24	Interaction 2.16

8.Biological yield g;

Table 9 showed significant differences in the average biological yield for the varieties, with V_3 giving the highest average value of 31.08 g and V_2 the lowest average value of 12.16 g. The reason for the difference in the efficiency of forming vegetative cover among the varieties is due to the interception of sunlight and the accumulation of dry matter, and consequently their difference in net photosynthesis per unit area (Shirinzadeh et al., 2017). The results in the same table showed that humic acid significantly affected the biological yield. Level H_1 achieved the highest average yield of 21.55 g, compared to the control level H_0, which recorded the lowest average of 19.21 g. The increase in the biological yield of wheat is a direct result of improved growth characteristics. Humic acid contributes to stimulating vital processes within the plant, leading to increased plant height, number of leaves, and leaf area. It also increases chlorophyll content, thus enhancing the efficiency of photosynthesis. All of this positively impacts plant growth and production, increasing the efficiency of nutrient resource utilization and consequently increasing the crop's biological yield (Baharuddin and Tejowulan 2021). The differences between the interactions of varieties and humic acid levels were significant and clear. Variety V_3 and humic acid level H_1 stated the highest interaction value of 32.67 g, while variety V_2 and humic acid level H_0 presented the lowest value of 11.32 g.

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Table 9. average values of varieties, humic acid, and their interaction in the Biological yield (g).

Varieties	Humic acid		Means
	H_1	H_0	
V_1	19.00	16.83	17.91
V_2	13.00	11.32	12.16
V_3	32.67	29.50	31.08
Means	21.55	19.21	
L.S.D 0.05	Varieties 1.02	Humic acid 0.83	Interaction 1.44

9.Harvest index%;

The harvest index is one of the most important indicators for evaluating variety efficiency. It is one of the important alternatives that breeders seek to use to increase the final yield of cereal crop products. It clearly highlights the role of plant parts above the soil surface in the distribution of metabolic products (Kobataa et al., 2018). The results of the averages in table 10 indicated significant differences between the three varieties, as variety V_2 gave the highest average harvest index of 32.49%, while variety V_1 gave the lowest average for the same trait of 18.96%. These results are consistent with (Al-Saedy and Al-Jubouri, 2016). Table 10 showed that humic acid had a significant effect on the harvest index. The H_1 level achieved the highest average yield 28.75% compared to the control level H_0, which recorded the lowest average yield 24.96%. The addition of humic acid, whether applied to the soil or as a foliar spray, significantly improves growth characteristics such as plant height, number of branches, individual plant yield, biological yield, and others (Bidyab et al., 2024). The interaction between varieties and humic acid levels was also significant. Variety V_2 and humic acid level H_1 showed the highest interaction 37.07%, while variety V_1 and humic acid level H_0 showed the lowest interaction 17.82%.

Table 10. average values of varieties, humic acid, and their interaction in Harvest Index % .

Varieties	Humic acid		Means
	H_1	H_0	
V_1	20.10	17.82	18.96
V_2	37.07	27.91	32.49
V_3	29.10	29.15	29.12
Means	28.75	24.96	
L.S.D 0.05	Varieties 1.92	Humic acid 1.57	Interaction 2.72

IV. Conclusion

The results obtained in this study show significant differences between the varieties in growth and yield characteristics. The varieties varied in their response to humic acid, with the Al-Rashid variety recording the highest averages for most of the studied traits. This study revealed that humic acid has significant positive effects on various agricultural parameters, with the H_1 application recording the highest average for all studied traits. The current study suggests that adopting the Al-Rashid variety and incorporating humic acid into agricultural practices may contribute to establishing productive and sustainable farming systems. These differences were attributed to variations in the study parameters and the environmental and genetic factors that control these traits.

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