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Response Oat crop (*Avena Sativa L.*) for different levels of elements for N,P,K and concentrations of humic acid

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I. Abstract

A field experiment was carried out in the fields of the Agricultural Research Station affiliated with the College of Agriculture - University of Basra, Iraq, in a clayey mixture soil during the winter agricultural season 2024-2025, with the aim of knowing the effect of four levels ofN, P and K are F_1 (0) F_2 (90:50:60 kg NPK ha^{-1}) F_3 (120:75:90 kg NPK ha^{-1}) F_4 (150:100:120 kg NPK ha^{-1}) and four concentrations of humic acid are H_1(0) H_2 (6 g L^{-1}) H_3 (12 g L^{-1}) H_4 (18 g L^{-1}). The experiment was carried out according to the factorial method using the randomized complete block design (RCBD) with three replicates.

The results showed that the fertilizer level (120:75:90 kg NPK h^{-1}) was superior significantly affected grain yield and biological yield (5.204 and 22.99 ton.ha^{-1}) In sequence As a result of its superiority in the number of panicles, the number of grains per panicle, and the weight of 1000 grains, it also has a superior protein yield (0.680 ton.ha^{-1}) As a result of the superiority of the protein percentage and grain yield, while the fertilizer level (150:100:120 kg NPK h^{-1}) was superior in the harvest index trait.

The concentration (18 g L^{-1}) recorded the highest number of panicles, number of grains per panicle, 1000-grain weight, grain yield, biological yield and harvest index. The concentration (12 g L^{-1}) achieved the highest protein percentage and protein yield.

I achievedTreatment of overlap between the fertilizer level (120: 75: 90 kg NPK h^{-1}) With spraying with humic acid at a concentration of 18 g L^{-1} The highest grain yield on average was 5,790 ton.ha^{-1} While he achieved fertilizer level (120: 75: 90 kg NPK h^{-1}) Spraying with humic acid at a concentration of 12 g L^{-1} Highest number of panicles, number of grains per panicle and percentage Protein percentage and protein quotient.

Keywords: oats, mineral fertilizers, organic fertilizers, yield

The research is taken from the researcher's master's thesis. first

II. Introduction

Oats are considered (Oats are an important cereal crop and belong to the Poaceae family. They are grown in many countries of the world as a dual-purpose crop for grain and fodder. 80% of oat-growing areas are located in temperate humid regions. The cultivated area in the world amounts to 8.70 million hectares, with a production of 22.49 million tons.(2025,USDA)Russia, Canada and Australia are among the leading oat-producing countries. Its importance stems from its many uses, including its use as a grain in human nutrition, especially in baby food, as it contains high levels of carbohydrates, proteins, fiber, vitamins and antioxidants, in addition to its high content of elements such as calcium, sodium, potassium, magnesium and phosphorus (Soni et al,2020.). As a result of the great benefits that oats provide, it has become necessary to pay attention to it to raise its production efficiency by paying attention to soil and crop service operations.

Providing nutrients during the crop growth period is very important because of their major role in increasing vegetative growth, which positively affects the increase in yield and quality of the produced grains, including nitrogen, phosphorus and potassium.

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The use of organic fertilizers has spread throughout the world to preserve the environment and health, as they are inexpensive, easy to use, and a substitute for many chemical substances, including humic acid, which is a complex, colloidal, chelated, amorphous organic compound consisting of groups with different functions. (Dong et al., 2008) and has an important role in plant growth, improving nutrient absorption and forming complexes with heavy elements, so it is widely used as a bio stimulant (Canellas et al., 2015; Qian et al., 2015). It consists of carbon, oxygen, hydrogen and nitrogen, as well as phosphorus, sulfur, iron, silicon and aluminum. It has an important role in plant growth and development through its effect on many vital processes in the plant (Ferrara and Brunetti, 2010).

Many studies have shown that there are differences in the yield and its components of the crop and the quality of the grains due to the addition of nitrogen, phosphorus, potassium and humic acid. It was found that (Jehangir et al, 2017) The protein content increases with increasing NPK levels. (Naser and Al-Mothefer, 2018) indicated an increase in the number of panicles per square meter, the number of grains per panicle, the weight of 1000 grains, and the grain yield at the level of 120: 30: 40 kg NPK h^{-1}. In a study to demonstrate the effect of spraying humic acid on oat yield, the concentration of 6 g L^{-1} significantly increased the number of panicles, the weight of 1000 grains, and the grain yield, while the concentration of 9 g L^{-1} achieved the highest protein percentage (Alabdulla, 2019). (Alfatlawi and Alrubaiee, 2020) confirmed that spraying with a concentration of 15 g L^{-1} of humic acid had a significant effect on increasing the number of spikes, the number of grains, the weight of 1000 grains, the grain yield, and the biological yield. (Al-Freeh, 2021) reported that spraying with a concentration of 9 g L^{-1} achieved the highest protein content in grains and protein yield. (ALrubaiee, 2021) found that spraying at a concentration of 4 g L^{-1} recorded the highest number of panicles, number of grains per panicle, weight of 1000 grains, grain yield, biological yield and harvest index, and (Ramadan, 2024) showed that the level of 150: 135: 210 kg NPK h^{-1} significantly exceeded the number of panicles, number of grains per panicle, weight of 1000 grains and grain yield for the two study areas.

III. MATERIAL AND METHODS

A field experiment was carried out in the fields of the Agricultural Research Station affiliated with the College of Agriculture - University of Basra, Iraq. Which is located on the longitude line For 47.80°and latitude30.57°In a clayey mixture soil, the chemical and physical properties of which are shown in Table (1) during the winter agricultural season 2024-2025, with the aim of knowing the response of the oat crop to different levels of N, P and K are F_1 (0) F_2 (90:50:60 kg NPK h^{-1}) F_3 (120:75:90 kg NPK h^{-1}) F4 (150:100:120 kg h^{-1}) and four concentrations of humic acid are H_1(0) H_2 (6 g L^{-1}) H_3 (12 g L^{-1}) H_4 (18 g L^{-1}) The experiment was carried out according to the factorial experiment method using the randomized complete block design RCBD and with three replicates. The different treatments were distributed randomly within each block so that the number of experimental units became (16) for each replicate and a total of (48) experimental units with an area of 3*2=6 m^2 for the experimental unit.

Table No. (1) Some physical and chemical properties of field soil

The adjective	value	Unity
PH	7.7	—
EC	8.24	Desi Simens M-1
OM	2.10	kg-1. Soil
Ready-made nitrogen	13.2	mg kg-1 soil
Ready-made phosphorus	26.25	
Ready-made potassium	166.4	
sand	160.41	kg-1. Soil

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	Green	477.07	
	clay	362.52	

The land designated for cultivation was prepared by plowing it with a rotary plough twice perpendicularly, then it was smoothed using disc harrows and leveled. Then the experimental land was divided according to the design used. The variety (Genzania) was planted on 1/11/2024. Which was obtained from the Department of Agricultural Research - Ministry of Agriculture at a seed rate of 120 kg ha^{-1} (Al-Husnawy, 2016), and the cultivation was in lines with a distance between each line and another 20 cm, meaning the number of lines is 11 lines and a length of 2 m for each experimental unit, and a distance of 70 cm was left between one sector and another and a distance of 50 cm between each experimental unit and another, to prevent interference between treatments, urea fertilizer (N%) 46 was added as a source of nitrogen in three batches, the first after seedling emergence, the second in the elongation stage and the third in the lining stage, and DAP fertilizer (P2O5 46%) was added as a source of phosphorus and nitrogen in one batch. When Agriculture, potassium sulfate was also added as a source of potassium (50%K2O) at once when Agriculture. All fertilizers were added in lines between and parallel to the planting lines. Humic acid was sprayed on the green parts of the plant in two batches, the first in the seedling stage and the second in the lining stage. Inforce was added (Enforce) at a rate of (2.5 cc) per 1 liters of water to ensure complete wetting, reduce the surface tension of the water and increase the efficiency of the spray solution in penetrating the cuticle layer of the vegetative group. The control treatment was sprayed with distilled water only. The spraying process was carried out in the evening to avoid high temperatures and air. A nylon barrier was used between the units during spraying to prevent the solution from transferring to the neighboring units. Irrigation was carried out immediately after planting and the process continued according to the plant's need. Manual weeding was carried out to get rid of weeds for all treatments and the weeding process continued whenever necessary.

The following characteristics were studied:

1-Number of panicles (m^{-2}): The Number of panicles was calculated in the two middle lines of the harvested area (40 x 100) cm and converted to m^2.

2-Number of grains in the panicle: The average number of grains was calculated for ten bunches randomly selected from the same harvested area.

3-The weight of a thousand grains (g): Estimate the weight of 1000 grains from the same harvested area and then weigh them with a sensitive balance.

4- Grain yield ton.ha^{-1}: According to the same harvested area after adding the weight of 1000 grains to the yield and converting on the basis of ton.ha^{-1}

5- Biological yield : It was calculated using the same harvested area and converted on the basis of ton.ha^{-1}

6- Harvest index: It was calculated from the

following equation.

Harvest index = (grain yield / biological yield) × 100.

7- Protein(%): The protein percentage was calculated based on the following equation:

Percentage of protein in grain = Percentage of nitrogen × 6.25

8- Protein yield (ton.ha^{-1}):It was calculated from the following equation:

Protein yield (ton.ha^{-1}) = Grain yield ×Protein %.

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IV. Results and Discussion

3-1. Number of panicles (m^{-2})

The results of Table (2) indicated that the two levels (120: 75: 90 kg NPK h^{-1}) were superior (150:100:120 kg NPK h^{-1}) was significant as they recorded the highest average number of vines, which reached 490.0 and 467.9 panicle.m^{-2} with an increase of 47.95 and 41.27% While the levels (0) and (90:50:60 kg NPK h^{-1}) were given The lowest two average number of vines was 331.2 and 410.4 panicle.m^{-2} The increase in the number of vines may be attributed to the role of nitrogen in cell division and expansion due to increased meristem tic activity, in addition to the role of phosphorus.in Root formation, strengthening of stems, and increase of vegetative growth components, thus increasing the availability of nutrients and water, which led to an increase in dry matter and thus an increase in the number of vines. Potassium also encourages root growth and increases vegetative growth. These results were consistent with what was reached by (Naser and AL Mothefer،2018) and (Ramadhan،2024) The results are shown in Table (2) Spraying with humic acid had a significant effect on this trait, as the concentration exceeded 18 g L^{-1}, giving the highest average for this trait, amounting to 462.9 panicle.m^{-2}, with an increase rate of 21.43% compared to the comparison treatment, which gave the lowest average for this trait, amounting to 381.2 panicle.m^{-2}.This may be attributed to the role of humic acid in promoting vegetative growth and plant development, as it increases the efficiency of photosynthesis and stimulates cell division. These results are consistent with the results of (Alabdulla،2019).

The results of Table (2) showed a significant interaction between Levels N, P, K and spraying with humic acid concentrations in this characteristic, so Record the fertilizer level ($F_3 \times H_3$)The highest average for this trait was 543.3 panicle.m^{-2}, while The combination($F_1 \times H_1$)The lowest average was 293.3 panicle.m^{-2}.

Table (2) Effect N, P, K, humic acid and their interaction in the Number of panicles (m^{-2})

Levels F	concentrations H g L-1				Mean F
	H1	H2	H3	H4	
F1	293.3	313.3	278.3	440.0	331.2
F2	361.7	443.3	420.0	416.7	410.4
F3	450.0	493.3	543.3	473.3	490.0
F4	420.0	455.0	475.0	521.7	467.9
Mean H	381.2	426.2	429.2	462.9	
LSD (P≤0.05)	N, P, and K		H	N, P, and K× H	
	35.57		35.57	71.14	

3-2 . Number of grains in the panicle (grains^{-1})

The results of Table (3) showed the moral superiority of the fertilizer level (120: 75: 90 kg NPK h^{-1}) as it achieved the highest number of grains in the vineyard with an average of 58.30 grains^{-1}bean Compared to the comparison treatment, which gave the lowest average number of grains in the vine, it reached 47.18 grains^{-1}This may be due to the positive effect of macronutrients, which play a role in activating many vital processes within the plant and thus regulating the work of hormones. As well as controlling the effect of auxin in causing dominance. Top In the vine, it contributes to increasing the grains on the axis of the vine, which has a positive effect on increasing the number of grains in one vine. This result is consistent with the results of (Naser and AL-mothefer، 2018) and (Ramadhan، 2024).

It is also noted from Table (3) that increasing the spraying with humic acid concentrations has a significant effect on the number of grains in the vine. The concentration achieved 18 g L^{-1} The highest average for this trait was 54.97 grains^{-1} with no significant difference from the concentration 12 g L^{-1} Compared to the lowest average of 49.07 grains^{-1} when not sprayed, this may be attributed to the role of humic acid in improving Bioavailability For

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nutrients (N, P, and K) which activates enzymes and stimulates metabolic and physiological processes. The acid also stimulates the formation of flower buds and increases the number of flowers by improving plant hormonal activity and the efficiency of nutrient absorption. These results are consistent with the results of (Alabdulla،2019).

As for the impact of the interaction between the two factors Record the fertilizer level($F_4 \times H_4$) The highest average for this trait was 61.52 grains^{-1}, which was not significantly different from Level ($F_3 \times H_3$) On average 61.43 grains^{-1} compared to the combination of both factors ($F_1 \times H_1$)Which achieved the lowest average of 43.33 grains^{-1}

Table (3) Effect N, P, K, humic acid and their interaction in the Number of grains in the panicle (grains^{-1})

Levels F	concentrations H g L-1				Mean F
	H1	H2	H3	H4	
F1	43.33	46.40	49.93	49.07	47.18
F2	48.83	45.57	51.93	51.27	49.40
F3	56.03	57.72	61.43	58.02	58.30
F4	48.10	50.78	53.83	61.52	53.56
Mean H	49.07	50.12	54.28	54.97	
LSD (P≤0.05)	N, P, and K		H	N, P, and K× H	
	2.081		2,081	4.162	

3-3. The weight of a thousand grains (g)

The results of Table 4 showed the significant superiority of the fertilizer level (120: 75: 90 kg NPK h^{-1}) recorded the highest average of 60.25 g With an increase rate of 4.03%, compared to the comparison treatment (no addition), which gave the lowest average for this characteristic, which amounted to 57.92 g This may be attributed to the balance of nutrients, which led to increased processing of nutrients from leaves to grains, thus achieving an ideal integration between the strength of the source and the efficiency of the Grain transportation and storage capacity Thus, increasing the dry matter and facilitating its transfer, which reduced the state of competition between the components of the crop and thus increasing these components. These results are consistent with the results of (Amjadian et al، 2021) and (Ramadhan ،2024) .

As for spraying with humic acid concentrations, the concentration of 18 g L^{-1} achieved the highest average for this trait 60.08 g Compared to the lowest average for this trait, it was 58.25 g Sad when not spraying, The reason may be due to the increase in the efficiency of vegetative growth as a result of spraying with humic acid, which was positively reflected on the efficiency of photosynthesis in the leaves and increased the number of panicles, which led to improved transfer of materials from the leaves (source) to the grains (drain). These results are consistent with the results of (Alabdulla ,2019) and Alfatlawi and (Alrubaiee، 2020).

Also, the interaction between the two factors has a moral impact, as it has achieved Level ($F_3 \times H_3$) The highest average weight of 1000 grains was 60.33 g, with no significant difference from the total. Fatah ($F_3 \times H_4$) Compared to the comparison combination of both factors ($F_1 \times H_1$) Which recorded the lowest average for this characteristic, amounting to 52.33 g.

Table (4) Effect N, P, K, humic acid and their interaction in the weight of a thousand grains (g)

Levels F	concentrations H g L-1				Mean F
	H1	H2	H3	H4	
F1	52.33	59.00	60.33	60.00	57.92
F2	60.00	58.33	59.00	60.00	59.33
F3	60.33	60.00	60.33	60.33	60.25
F4	60.33	59.33	59.67	60.00	59.83

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Mean H	**58.25**	**59.17**	**59.83**	**60.08**	
LSD (P≤0.05)	N, P, and K		H	N, P, and K× H	
	0.961		**0.961**	**1.921**	

4-3. Grain yield (ton.ha^{-1})

The results of Table (5) indicated the moral superiority of the fertilizer treatment (120: 75: 90 kg NPK h^{-1}) recorded the highest average grain yield of 5.204 ton.ha^{-1} With an increase of 28.18% compared to the lowest average grain yield of 4.060 ton.ha^{-1} When dealing with comparison This may be due to the increase in the number of panicles (Table 2), and then the increase in the number of grains in the panicle (Table 3), and then the weight of 1000 grains (Table 4). These components reflect the final result of all the vital processes that occur in the plant throughout its life cycle. Agreed These results and (Naser and AL-mothefer، 2018) and (Ramadhan ، 2024).

like that Spraying with humic acid concentrations was significantly superior in this trait, as the concentration of 18 g L^{-1} achieved the highest average grain yield, reaching 5.322 ton.ha^{-1} With an increase of 32.09% compared to the comparison treatment, which gave the lowest average grain yield of 4.029 ton.ha^{-1} This may be due to the increase in the number of panicles (Table 2) and then the increase in the number of grains in the panicle (Table 3) and then the weight of 1000 grains (Table 4). These components reflect the result of all the vital processes that occur in the plant throughout its life cycle. These results are consistent with (Alabdulla، 2019) and (ALrubaiee ، 2021).

As for the overlap between the two factors, it has been achieved. The combination (F_3×H_4) The highest average grain yield was 5.790 ton.ha^{-1} It did not differ morally from Level(F_4×H_4)Spraying with humic acid concentration with an average of 5.637 ton.ha^{-1} , while giving blend Comparison of both factors (F_1×H_1)The minimum grain yield was 2,240 ton.ha^{-1}

Table (5) Effect N, P, K, humic acid and their interaction on grain yield (ton.ha^{-1})

Levels	**concentrations H g L-1**				**Mean**
F	**H1**	**H2**	**H3**	**H4**	**F**
F1	**2,240**	**4,587**	**4.373**	**5,040**	**4,060**
F2	**4,187**	**3,960**	**4.643**	**4,820**	**4,402**
F3	**4.925**	**4.601**	**5,501**	**5,790**	**5.204**
F4	**4.763**	**4,937**	**4.963**	**5.637**	**5.075**
Mean H	**4,029**	**4,521**	**4,870**	**5.322**	
LSD (P≤0.05)	**N, P, and K**		**H**	**N, P, and K× H**	
	0.3477		**0.3477**	**0.6953**	

3-5. biological yield (ton.ha^{-1})

The results of Table (6) showed the moral superiority of the fertilizer level (120: 75: 90 kg NPK h^{-1}) recorded the highest biological yield with an average of 22.99 ton.ha^{-1} and an increase rate of 30.40% compared to the

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comparison treatment (no addition), which gave the lowest average for this trait, amounting to 17.63 ton.ha^{-1}. It is known that the biological yield is the result of both the grain yield and the straw yield, and each of these two yields has its components, and the reasons that lead to an increase These ingredients will definitely increase your bioavailability.

Spraying with humic acid concentrations had a significant effect on the biological yield trait, as the concentration of 18 g L^{-1} recorded the highest average for this trait, amounting to 22.14 ton.ha^{-1} With an increase of 16.71%, compared to the lowest average of 18.97% ton.ha^{-1} When not spraying, it may be due to: The biological yield is the result of both the grain yield and the dry plant yield, and the combined role of the nutritional elements led to an increase in the components of vegetative growth as well as an increase in the grain yield, Table (5). By increasing these components, the biological yield increased. These results were consistent with(Alfatlawi and Alrubaiee، 2020).

There was no significant effect of the interaction between fertilizer levels and humic acid concentrations on the biological yield trait (Table 6).

Table (6) Effect N, P, K, humic acid and their interaction in the biological yield (ton.ha^{-1})

Levels F	concentrations H g L-1				Mean F
	H1	H2	H3	H4	
F1	15.41	17.29	18.11	19.71	17.63
F2	20.02	20.81	20.3	22.23	20.84
F3	21.93	22.7	23.76	23.57	22.99
F4	18.54	19.37	20.18	23.05	20.28
Mean H	18.97	20.04	20.59	22.14	
LSD (P≤0.05)	N, P, and K		H	N, P, and K× H	
	0.870		0.870	N.S	

3-6. Harvest Index (%)

The results of Table (7) showed that the fertilizer level (150: 100: 120 kg NPK h^{-1}) was significantly superior, as it recorded the highest average harvest index of 25.06%, with an increase rate of 10.08%. Compared to the comparison treatment, which gave the lowest average for this trait, which was 22.77%.,The reason for the superiority of the high fertilizer level in the harvest index may be due to the low biological yield (Table 6) for this treatment, while the grain yield (Table 5) for the same treatment is superior.

Spraying with humic acid concentrations had a significant effect on the harvest index, as it gave the highest average of 24.09%, with an increase rate of 15.10% at a concentration of 18 gL^{-1}, compared to the lowest average of 20.93% when not sprayed. This is due to the superiority of the same concentration of 18 gL^{-1} in the grain yield, Table (5), as a result of its superiority in the components of the yield, which are the number of panicles, the number of grains in the panicle, and the weight of a thousand grains, Tables (2, 3, and 4).These results are consistent with the results of(ALrubaiee، 2021) indicated that the harvest index of oats increased with increasing humic acid concentrations..

As for the effect of the interaction between the two factors, there were significant differences, as it was recorded that The combination $F_1 \times H_2$ gave the highest average for this trait, reaching 26.57%, while the combination $F_1 \times H_1$ gave the lowest average for this trait, reaching 14.55%.

Table (7) Effect N, P, K, humic acid and their interaction in the indicator Harvest index (%)

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Levels F	concentrations H g L-1				Mean F
	H1	H2	H3	H4	
F1	14.55	26.57	24.35	25.59	22.77
F2	20.90	19.06	23.38	21.71	21.26
F3	22.48	20.27	23.15	24.57	22.62
F4	25.77	25.37	24.62	24.47	25.06
Mean H	20.93	22.82	23.88	24.09	
LSD (P≤0.05)	N, P, and K		H	N, P, and K× H	
	1.976		1.976	3.951	

3-7. protein(%)

The results of Table (8) showed the moral superiority of the fertilizer level (120: 75: 90 kg NPK h^{-1}) recorded the highest percentage of protein in grains with an average of 12.992% and an increase rate of 87.96% compared to the comparison treatment, which gave the lowest average percentage of protein in grains, amounting to 6.912%.The reason is attributed to the positive role of the added elements in improving growth conditions and increasing their absorption, thus increasing the dry matter formed and facilitating its transfer, and because of their role. In formation Amino acids, which are the basic building blocks of proteins. As well as in the formation of roots and increasing the absorption centers in them. Phosphorus also plays an important role in the growth, development and spread of roots, helps the plant increase the absorption of elements, regulate the process of photosynthesis and respiration and activate enzymes in the plant. In addition to the role of potassium, which contributes to the process of protein synthesis by producing new protein chains through its role in releasing the newly formed protein from the ribosome, this result is consistent with the results of (Kovačević et al، 2013) and(Jehangir et al، 2017) who found that the protein content of oat crop increased with increasing NPK levels.

Spraying with humic acid concentration had a significant effect, as the concentration of 12 g L^{-1} achieved the highest average protein percentage in grains, reaching 10.699%, with an increase rate of 28.75%, and did not differ significantly from the concentration of 18 g L^{-1}, with an average of 10.119% compared to the comparison treatment (when not sprayed), which gave the lowest average for this trait, reaching 8.310%. These results are consistent with (Alabdulla ،2019) and (Al-Freeh ، 2021), which indicated an increase in the protein content of oat crops with increasing humic acid concentrations.

The interaction has a moral effect on percentage of protein I have achieved the combination $F_3 \times H_3$ achieved the highest average of 15.140%, while the $F_1 \times H_1$ combination achieved the lowest average for this trait of 6.783%.

Table (8) Effect N, P, K, humic acid and their interaction in protein %

Levels F	concentrations H g L-1				Mean F
	H1	H2	H3	H4	
F1	6,783	6,853	6,783	7.227	6,912
F2	7,773	11,340	13,977	12,640	11,433
F3	11,730	11,587	15,140	13,510	12,992
F4	6,953	6,753	6,897	7,100	6,926
Mean H	8,310	9.133	10,699	10,119	
LSD (P≤0.05)	N, P, and K		H	N, P, and K× H	
	0.2507		0.2507	0.5015	

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8-3. Protein yield (ton.ha^{-1})

The results of Table (9) indicated the moral superiority of the fertilizer level (120: 75: 90 kg NPK h^{-1}) recorded the highest average protein yield of 0.6804 ton.ha^{-1} With an increase rate of 138.07% compared to the comparison treatment, which gave the lowest average protein yield of 0.2858 ton.ha^{-1} This increase may be due to the higher level (120: 75: 90 kg NPK h^{-1}) in grain yield (Table 5) and protein percentage (Table 8).
Humic acid concentrations had a significant effect on this trait. The concentrations of 12 g L^{-1} and 18 g L^{-1} recorded the highest average protein yields of 0.5313 and 0.5420 ton.ha^{-1}Without any significant difference, with an increase rate of 53.47 and 56.57%, and a significant difference from the concentrations of 0 and 6 g L^{-1}, which recorded the lowest average protein yield of 0.3462 and 0.4069. ton.ha^{-1} This may be due to the increased grain yield and protein percentage. These results are consistent with (Al-Freeh ، 2021) confirmed that the protein yield of oats increased with increasing humic acid concentrations. The interaction effect between the two factors was significant, as the $F_3 \times H_3$ combination achieved the highest mean for this trait, reaching 0.8323 ton.ha^{-1} Compared to the comparison combination $F_1 \times H_1$ which gave the lowest mean for this trait was 0.1510 ton.ha^{-1}

Table (9) Effect N, P, K, humic acid and their interaction in protein yield (ton.ha^{-1})

Levels F	concentrations H g L-1				Mean F
	H1	H2	H3	H4	
F1	0.1510	0.3143	0.2957	0.3823	0.2858
F2	0.3257	0.4477	0.6487	0.6063	0.5071
F3	0.5770	0.5330	0.8323	0.7793	0.6804
F4	0.3310	0.3327	0.3487	0.4000	0.3531
Mean H	0.3462	0.4069	0.5313	0.5420	
LSD (P≤0.05)	N, P, and K		H	N, P, and K× H	
	0.03561		0.03561	0.07123	

V. Conclusion

We conclude from this research that the levels of fertilizer KPN varies in grain yield characteristics through variation in the components of the yield with the superiority of high levels of added elements in addition to the presence of differences in qualitative characteristics. We also conclude from spraying oat plants with different concentrations of humic acid, where high concentrations achieved an increase in grain yield to increase the components of the yield and improve its qualitative characteristics by increasing the percentage of protein.

VI. REFERENCES

Alabdulla, S. A. (2019). Effect of foliar application of humic acid on fodder and grain yield of oat (Avena sativa L.). *Research on crops*, *20*(4): 880-885.

Alfatlawi, Z. H. C., & Alrubaiee, S. H. A. W. (2020). Effect of spraying different concentrations of humic acid on the growth and yield of wheat crop (ipa 99 cultivar) in different stages. Plant Archives, 20(2), 1517-1521.

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https://iasj.rdd.edu.iq/journals/journal/issue/18682 https://doi.org/10.54174/utjagr.v13i1.323

Al-Freeh, L. M. (2021). Influence of spraying with humic acid and the number of cutting on Forage Yield of Oat (Avena sativa L.). *Indian Ecological Society*, *48*(18): 86-89.

Al-Husnawy,Asmaa sahib Al-Abbas(2016). effect of nitrogen fertilization levels, Row spacing and seeding rate on the growth and productivity of oat (Avena sativa L.) Master's thesis, College of Agriculture, Al-Muthanna University.

ALrubaiee, S. H. (2021). Response of three cultivars of oats (Avena sativa L.) to humic acid and its effect on yield and its components. *Int. J. Agricult. Stat. Sci.*, *17*(1): 2201-2205.

Amjadian, E., Zeinodini, A., & Doğan, H. (2021). Effect of fertilizer management systems on growth and balance of nutrients in wheat cultivation. *Central Asian Journal of Plant Science Innovation*, *1*(2), 56-69.

Canellas, L.P.; Olivares, F.L.; Aguiar, N.O.; Jones, D.L.; Nebbioso, A.; Mazzei, P.; Piccolo, A.(2015) Humic and fulvic acids as biostimulants in horticulture. Sci. Hortic. 196, 15–27.

Dong, L.; Yang, J.; Yuan, H.; Wang, E.; Chen, W. (2008) Chemical characteristics and influences of two fractions of Chinese lignite humic acids on urease. Eur. J. Soil Biol.44(1), 166–171.

Ferrara ,G. and Brunetti, G. (2010). Effects of the times of application of a soil humic acid on berry quality of the table grape (*Vitis vinifera* L.) Italia. Spanish J. of Agric.Res.8(3):817-822.

Jehangir, I. A., Panotra, N. A. R. I. N. D. E. R., Bhat, M. A., & Singh, P. U. R. S. H. O. T. A. M. (2017). Nutrient uptake and quality of oats (Avena sativa L.) as influenced by different agronomic practices. Forage Research, 42(4): 263-66

Kovačević, V., Kadar, I., Rastija, M., & Sudar, R. (2013). Impacts of NPK fertilization on chemical composition of wheat grain

NASER, A., & AL-MOTHEFER, A. A. (2018). Effect of seeding quantity and chemical fertilizer on growth and grain yield of oats (Avena sativa L.). Jornal of Al-Muthanna for Agricultural Sciences, 6(1), 77

Qian, S.; W.Ding ; Y. Li ; G. Liu ; J. Sun and Q. Ding (2015) Characterization of humic acids derived from Leonardite using a solid-state NMR spectroscopy and effects of humic acids on growth and nutrient uptake of snap bean. Chem. Speciat. Bioavailab. 2015, 27, 156–161

Ramadhan, M. N. (2024). Assessment of the yield and yield attributing characters of oat (Avena sativa L.) grown under different tillage methods and NPK fertilizer rates in semi-arid conditions. All Life, 17(1): 2304338

Soni, P.; Sharma, K. D.; Sharma, S.; Mehta, V. and Attri, S. (2020). Development of apple pomace enriched oat flourbiscuits and its quality evaluation during storage. Int J Curr Microbiol Appl Sci, 9: 2642-52.

USDA. (2025). World Agriculture Production. foreign agriculture service. Global Market Analysis. Washington