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EFFECT OF SPRAYING DIFFERENT CONCENTRATIONS OF HUMIC ACID ON THE GROWTH AND YIELD OF WHEAT CROP (IPA 99 CULTIVAR) IN DIFFERENT STAGES

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Abstract

A field experiment was conducted for the season 2019-2020 in the experimental field belonging to the Department of Field Crops, College of Agriculture, Al-Qasim Green University, to study the effect of spraying Humic acid in different stages on the wheat crop, The factorial experiment was applied according to the Randomized Complete Block Design (RCBD) with three replicates. The experiment included the study of two factors: the effect of spraying humic acid in different stages is (T1 elongation stage-T2 Heading stage-T3 flowering stage) and four concentrations are (0-5-10-15-15 g/ L) and which symbolized by (N0-N1-N2-N3), respectively. The results indicated the excelled of the spray treatment at a concentration of 15 g /L in the plant height, the flag leaf, the leaf content of chlorophyll, the number of spikes per square meter, the number of grains per spike, the total grain yield and the biological yield, as well as the treatment spraying in the flowering stage in the number of spikes per square meter, the number of grains per spike and the total grain yield and The biologist yield, While no significant differences were observed for the acid spraying stages in the trait of the plant height, the flag leaf and the leaf content of chlorophyll. As for the traits of the 1000 grain weight, no differences were observed in both study and interaction factors. Also, significant differences were observed between the interaction factors in the leaf content of chlorophyll, the number of spikes, the grain yield and the biologist yield, while the rest of the traits did not show any significant differences for the interaction factors.

***Keywords*:** Humic acid, sprayings stages, wheat.

Introduction

Wheat crop *Triticum asetivum* L. is the first crop in the world among the crops used in food in terms of economic importance, cultivated area and annual production volume, where this grain is the main source of energy that a person needs to increase its nutritional value because it contains a high percentage of proteins and carbohydrates (FAO, 2009). That the Iraq soil contains a high percentage of lime and soil interaction tends to be basic and the lack of organic matter has led to the need to add some organic matter to the soil to improve their chemical and physical properties, and from these materials are humic acid, which is a complex compound that arises from the gradual degradation of organic matter by means of various microorganisms, Humic is formed as a result of the transformation of plant remains under the influence of the biological reactions of microorganisms, In addition to that the plant suffers from a problem of lack of phosphorous, especially in soils with a high acidity number, where the problem of phosphate fertilizers is lost and fixed in the soil, whether in solid or liquid form and the suffering of crops increases when the temperature decreases and this leads to slow growth and delayed ripening in many crops Therefore, humic acids have a role in improving the absorption of phosphorous from the compound fertilizers because of the presence of an amine group on humic acids that absorb phosphate cations and improve plant productivity. (Chen *et al*., 2004) explain that adding humic acid has a role in improving the absorption of nitrogen from the soil, increasing the absorption of potassium, calcium, magnesium, and phosphorus and making them more available for the plant root system. Hellal, (2007) mentioned that the use of humic acid has improved nutrient values with a significant correlation between the total content of organic matter and humic acid as well as the reason for a significant increase in the yield of grains and straw. Humic acid has an effect on plant growth by activating enzymatic reactions, increasing the permeability of cell membranes, increasing cell division and elongation, increasing the amount of plant enzymes and activating vitamins inside cells. Spraying humic to plants improves plant growth, nutrient absorption, and crop growth. As many studies have proven that this acid reduced the amount of fertilizer added to the soil, which leads to a reduction in the cost and pollution of chemical fertilizers without affecting the yield (Pettit, 2003). and due to the lack of studies in Iraq in general and Babylon province in particular, this study was conducted, which aims to determine the best stages of plant growth in response to spraying this acid and with the best concentration to obtain a good yield in terms of growth and yield traits.

Materials and Methods

A field experiment was conducted for the season 2019-2020 in the experimental field of the Department of Field Crops, College of Agriculture, University of Al-Qasim Green, located within the geographical limits of the University of Babylon, and within the longitude 44.39 and width 32.30, The experiment soil was tillage and smoothing with disc harrows and samples were taken from the field soil before the start of cultivation in order to know the chemical and physical characteristics of it. The samples were analyzed in the Laboratory of Soil Department, College of Agriculture, Al Qasim green University and the results were as shown in Table (1).

Table 1 : Shows the physical and chemical properties of the field soil

Traits	Values
pH	**7.7**
(dSm-1) EC	4.7
Nitrogen availability mg.kg^{-1}	21.2
Phosphorus availability mg.kg^{-1}	24.4
Potassium availability mg.kg^{-1}	382
Organic matter%	1.37
Soil components	
Sand g.Kg^{-1}	225
Silt g.Kg^{-1}	346
Clay g.Kg^{-1}	429
Soil Texture	silty clay loam

The factorial experiment was applied according to the Randomized Complete Block Design (RCBD)with three replicates. The experiment included a study of two factors: the effect of spraying Humic acid in different stages are: (T1 elongation stage - T2 Heading stage - T3 flowering stage) and four concentrations are (0-5-10-15-15) g/L and which symbolized by (N0-N1-N2-N3), respectively. treatments were distributed randomly, and the experimental unit area was 16 m^2 with a length of 4 m and a width of 4 m, and the distance between the lines was 20 cm, and the IPA 99 seeds cultivars were distributed on 30/ 11/2018 at a seed average of 40 kg/dunum. The experiment land was irrigated immediately after cultivated, and surface irrigation continued throughout the growth period. Also, triple superphosphate fertilizer (45%) was added at an average of 25 kg/dunum where one batch when preparing the ground, and nitrogen fertilizer (N 46%) was added at an average of 50 kg / dunum in two batches. The first in the tillering stage and the second in the Heading stage , In addition to spraying Humic acid, which is part to spray in three-stage (elongation stage - Heading stage - flowering stage), The weeds, which appeared in a small percentage in the experimental units and in the field in general, were controlled by manual method (weeding and hoeing) in two stages, and the following traits were studied:

A- Vegetative traits:

1- The plant height (cm):

The plant height was measured as an average of ten plants from the soil surface to the top of the spike (peripheral spike) without own per experimental unit (Khan and Splide, 1992).

2- The Flag Leaf area (cm^2):

It was calculated from an average of 10 flag leaf for the main stems per experimental unit at 100% flowering stage and according to the formula (1975, Thomas)).

The Flag Leaf area (cm^2) = flag length x width at center x correction coefficient 0.95

3- The flag leaf content of chlorophyll (SPAD):

Ten plants were read from each experimental unit after flowering was completed by the Chlorophyll meter.

4- Biological yield ($tons.ha^{-1}$):

A measure of all the existing plants from the area of 1 m^2 harvested for each experimental unit, where the whole plants were weighed (grains + straw) and then transferred the weight from g. M2 to a $ton.ha^{-1}$.

B- The traits of the yield and its components:

1- Number of spikes (spike/m^2):

According to all plants harvested from 1m^2 of the three intermediate lines guarded from each experimental unit.

2- Number of grains/spike:

The average number of grains of 10 spike per experimental unit was taken after manually separating and cleaning the spike. The number of grains was calculated for each spike.

3- The 1000 grain weight (g):

The 1000 grain were randomly calculated from each experimental unit from the final yield using the Seed counter type Contador seed meter found in the Seed Technology Laboratory, Department of Field Crops ,College of Agriculture, University of Al-Qasim green, then each sample was weighed for each experimental unit, and moisture measurement for the grains at 14% humidity level (Hossain *et al*., 2013).

4- The grain yield ($tons.ha^{-1}$):

Manual study of plants harvested from 1m^2 of the three middle lines was conducted and straw was isolated from the grains and cleaned well and then the grains were weighed, after the grains used in estimating the weight of 1000 grains for the same treatment were added, and the weight was then from g^{-1} to ton $.ha^{-1}$ (AOAC, 1975).

Results and Discussion

The plant height (cm)

Table (2) showed that there are significant differences between the concentrations of spraying Humic acid fertilizer, where it is noted that the fourth level excelled the trait of plant height and gave the highest average amounted to 105.56 cm compared to the treatment without spraying that gave the lowest average amounted to 81.93 cm, and the reason for that is due to the role of organic acid in increasing cell division and cell elongation, where the humic acids improve the balance of cells and occur at the highest average of growth and the best conditions for cell division, which have a role in increasing the average of plant height through its positive effect in the process of division and elongation of cells by providing a good expansion of the cellular wall necessary for the growth and division processes was clearly reflected in the height increase (Shabaan *et al*. 2009), This is consistent with what was found by (Zeboon and Baqir, 2019) who indicated that there were significant differences when spraying Humic acid, but as for the interaction between workers and stages of spraying Humic acid, no significant differences were observed.

The flag leaf area (cm^2)

The result in Table (3)showed that there were significant differences when spraying Humic acid, where the sprayed treatment with a concentration of 15 ml significantly excelled with an average amounted to 34.21 cm^2 compared to the control treatment that gave the lowest average amounted to 29.31 cm^2 and perhaps the reason for this is that spraying acids caused the increase in the biological activity of the plant including the absorption of nutrients and thus increasing the effectiveness of enzymes activity in addition to increasing the production of chlorophyll content Table (4) and the formation of sugars and amino acids that contribute effectively to raising the efficiency of photosynthesis and thus Increase the flag leaf area. These results agree with (Zeboon, 2019, Baqir) who indicated that there are significant differences when spraying Humic acid, and it is noted that there were no significant differences in the stages of spraying Humic acid and between the interaction factors.

The flag leaf content of chlorophyll (SPAD).

It is noted from Table (4) that there were significant differences between the study factors in the average plant content of chlorophyll, where Humic acid spray treatment concentration of 15 ml was significantly excelled and gave average amounted to 59.10 spad ,compared to the control treatment that gave the lowest average amounted to 42.73

spad, Perhaps the reason for this is that spraying the acid caused the increase in the biological activity of the plant, including the absorption of nutrients, and thus increasing the effectiveness of the activity of enzymes, which was reflected positively by increasing the efficiency of photosynthesis, which led to an increase in the production of leaf content of chlorophyll (Pettit and Robert, 2003). It is also noted from the table that there were no significant differences for the acid spray stages and between the interaction factors.

The number of spikes/m^2

It is noted from Table (5) that there were significant differences between the study factors, where the treatment of Humic acid spray a concentration of 15 ml was significantly excelled and gave an average of 221.0 spike /m^2 compared to the control treatment that gave the lowest average amounted to 170.2 spike /m^2, While the Humic acid spraying stages, where the treatment of spraying in the flowering stage significantly increased by an average of 205.8 spike /m^2 compared to the other stages. The reason for this is probably because the repeated spraying of plants with more humic acid doses leads to encouraging photosynthesis in the production of carbohydrates and the speed of their transport to places of growth, and this reduces the state of competition within a single plant and pushes towards increasing the number of spikes (Muhammad and others 2009), as well significant differences were observed between the interaction factors, where the N3T2 combination was significantly excelled with an average amounted to 233.3 spike /m^2 compared to the N1T1 combination which gave the lowest average amounted to 159.0 spike /m^2.

Number of grains / spike

Table (6) shows significant differences between concentrations and stages of spraying Humic acid in the trait number of grains, noting that the treatment of spraying the fourth concentration was significantly excelled with an average amounted to 58.67 grains/spike compared to the treatment without spraying, where it gave the lowest average amounted to 42.11 grains/ spike, The reason for this is due to the role that organic fertilizer plays in raising the efficiency of photosynthesis and providing appropriate opportunities to reduce the condition of falling flowers by reducing the state of competition between them over the food product. The results show the excelled of the spray treatment in the Heading and flowering stages significantly with an average of (53.50 and 53.75) in succession compared to the treatment of spraying in the elongation stage that gave the lowest average amounted to 45.25 grains/spike, The reason for this is due to the frequent spraying of humic acids, which led to creating a better incentive for the growth and development of photosynthesis and an increase in the readiness of nutrients in the humic organic acid that came concurrently with spraying at the beginning of the Heading and flowering stages, which encouraged a better growth of the number of spike (Table 5) which was reflected clearly increased the number of grains (Muhammad *et al*. 2014). It is also noted from the table that there were no significant differences in the interaction between the factors.

Weight of 1000 grain / g

It is noted from Table (7) that there were no significant differences between the concentrations and stages of spraying Humic acid and the interaction between them in the weight of a thousand grain.

The grain yield ton / ha

It is noted from Table (8) that there were significant differences between the concentrations and stages of spraying Humic acid and the interaction between them in the trait of grain yield, where the treatment of acid spraying at a concentration of 15 ml excelled in this trait and gave the highest average amounted to 3.99 tons.ha^{-1} while the treatment without spraying gave the lowest average amounted to 2.55 tons.ha^{-1}, It is also noticed from the table that the humic acid spraying in the flowering stage was significantly excelled with an average amounted to 3,422 tons.ha^{-1}compared to spraying at the elongation and Heading stages which gave the lowest average amounted to 3.106 and 3.183 tons.ha^{-1} respectively, The reason for this is that the organic fertilizer gives the plant greater opportunities to benefit from the nutrients in increasing the number of spikes (5) and the number of grains per spike (6) which was positively reflected in the increase in the total grain yield (Muhammad *et al*. 2014). As for the interaction, the combination N4T3 excelled significantly, with an average amounted to 4.05 tons.ha^{-1} , while the combination N1T1 gave the lowest average amounted to 2.03 tons.ha^{-1}.

The biological yield tons.ha^{-1}

The results in Table (9) showed that there are significant differences between the concentrations and stages of spraying Humic acid and the interaction between them in the trait of the biological yield, where the treatment of acid spraying was distinguished by a concentration of 15 ml in this trait and gave the highest average amounted to 12.47 tons.ha^{-1}, while treatment without spraying was the lowest average amounted to 8.38 tons.ha^{-1}, and this excelled may be due to increased plant height, increased leaf area and chlorophyll content for the same concentration and this is consistent with what Zeboon (and Baqir 2019) indicated, which indicated significant differences when spraying Humic acid, It is also noticed from the table that the humic acid spraying in the flowering stage was significantly excelled with an average amounted to 10.37 tons.ha^{-1} measured by spraying the elongation and Heading stages, which gave the lowest average amounted to 9.96 and 10.23 tons.ha^{-1} respectively, and the reason for this may be that recurrent additions of humic acid have led to an increase in most studied traits because this acid contains amino acids and nutrients that have created adequate conditions to stimulate the process of photosynthesis and provide an abundance of food and reflected by increasing most of the yield components and thus This was reflected positively by the increase in the biological yield. As for the interaction, the combination N4T3 was significantly excelled, with an average amounted to 12.56 tons.ha^{-1}, while the combination N1T1 gave the lowest average amounted to 6.79 tons.ha^{-1}.

Table 2 : Effect of humic acid concentrations and spraying stages on plant height trait (cm)

The average of spraying stages	N4	N3	N2	N1	Concentrations / Spraying stages
93.57	106.60	90.80	93.50	83.40	T1
95.39	105.80	97.10	96.83	81.83	T2
92.04	104.27	92.60	90.73	80.57	T3
LSD 5% N=4.5, T=NS N*T =NS	105.56	93.50	93.69	81.93	The average of Concentrations (N)

Table 3 : Effect of humic acid concentrations and spraying stages on the leaf area trait(cm^2)

The average of spraying stages	N4	N3	N2	N1	Concentrations / Spraying stages
32.83	36.70	34.47	31.23	28.90	T1
31.40	33.53	32.80	29.83	29.43	T2
30.71	32.40	31.37	29.47	29.60	T3
LSD 5% N=1.6 , T=NS N*T =NS	34.21	32.88	30.18	29.31	The average of Concentrations (N)

Table 4 : Effect of humic acid concentrations and spraying stages on the flag leaf content of chlorophyll (SPAD)

The average of spraying stages	N4	N3	N2	N1	Concentrations / Spraying stages
51.39	61.77	56.47	45.87	41.47	T1
54.18	60.80	53.67	58.17	44.10	T2
53.84	54.73	61.03	56.97	42.63	T3
LSD 5% N=2.6, T=NS N*T =4.4	59.10	57.06	53.67	42.73	The average of Concentrations (N)

Table 5 : Effect of humic acid concentrations and spraying stages on the number of spike /m^2

The average of spraying stages	N4	N3	N2	N1	Concentrations / Spraying stages
175.2	209.7	164.0	168.3	159.0	T1
203.0	228.7	233.3	180.3	169.7	T2
205.8	224.6	189.3	227.3	182.0	T3
LSD 5% N=9.9 ,T=11.4 N*T =19.8	221.0	195.6	192.0	170.2	The average of Concentrations (N)

Table 6 : Effect of humic acid concentrations and spraying stages on the number of grains / spike

The average of spraying stages	N4	N3	N2	N1	Concentrations / Spraying stages
45.25	55.67	48.0	39.3	38.0	T1
53.50	60.00	58.67	53.3	42.0	T2
53.75	60.33	59.68	48.67	46.33	T3
LSD 5% N=1.9, T=1.7 N*T =NS	58.67	55.44	47.11	42.11	The average of Concentrations (N)

Table 7 : Effect of humic acid concentrations and spraying stages on the Weight of 1000 grain / g

The average of spraying stages	N4	N3	N2	N1	Concentrations / Spraying stages
39.24	42.00	40.17	37.97	36.83	T1
37.10	37.60	39.75	34.33	36.73	T2
35.31	37.58	35.00	35.37	33.30	T3
LSD 5% N=NS, T=NS N*T =NS	39.06	38.31	35.89	35.62	The average of Concentrations (N)

Table 8 : Effect of humic acid concentrations and spraying stages on the grain yield ton / ha

The average of spraying stages	N4	N3	N2	N1	Concentrations / Spraying stages
3.106	3.92	3.84	2.64	2.03	T1
3.183	3.99	2.98	2.95	2.81	T2
3.422	4.05	3.87	2.95	2.82	T3
LSD 5% N=0.1 ,T=0.12 N*T =0.21	3.99	3.56	2.85	2.55	The average of Concentrations (N)

Table 9 : Effect of humic acid concentrations and spraying stages on the biological yield tons.ha^{-1}

The average of spraying stages	N4	N3	N2	N1	Concentrations / Spraying stages
9.96	12.30	12.11	8.63	6.79	T1
10.23	12.53	9.65	9.57	9.15	T2
10.87	12.56	12.17	9.55	9.19	T3
LSD 5% N=0.36, T=0.30 N*T =0.62	12.47	11.31	9.25	8.38	The average of Concentrations (N)

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