ROLE OF HUMIC ACID IN IMPROVING GROWTH CHARACTERS OF CORN UNDER WATER STRESS

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ABSTRACT

A field experiment was carried out to study the role of humic acid in improving some growth characters of corn (*Zea mays* L.) under water stress conditions during fall of seasons 2016, 2017, by using randomized complete block design within split plot arrangement and three replications. The study consisted of three levels of water stress, when depleting 50, 60 and 70% of available water which was equivalent to 580, 420 and 340 mm season^{-1} respectively, and occupied the main plot, while the levels of humic acid 0, 40, 60 and 80 kg^{-1} were in sub plots. The results showed no significant differences between the treatments of depletion 50% and 60% of the available water in number of days to tasseling, number of leaves, leaf area, leaf area index, dry weight of the plant and the crop growth rate in both seasons. Plants under water70% depletion produced the lowest means for studied traits. The addition of humic acid with 80 kg h^{-1} had the highest plant height, number of leaves, leaf area, leaf index, dry matter and crop growth rate. The effect of interaction between two variables was significant for all the studied traits except the number of days to tasseling and number of leaves plant^{-1}. It could be concluded that in the case of limitd irrigation water, It could be irrigation with 60% of the available water with 80 Kg ha^{-1} humic acid is practiced.

Key words: irrigation, water depletion, crop growth rate, plant dry matter.

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دور حامض الهيومك في تحسين صفات النمو لنباتات الذرة الصفراء تحت الاجهاد المائي

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المستخلص

نفذت تجربة حقلية بهدف دراسة دور حامض الهيومك في بعض صفات النمو لمحصول الذرة الصفراء النامية تحت ظروف الإجهاد المائي خلال الموسمين الخريفيين 2016 و 2017. أستعمل تصميم القطاعات الكاملة المعشاة وبترتيب الالواح المنشقة. أشتملت الدراسة على ثلاثة مستويات من الإجهاد المائي عند أستنزف 50 و60 و70 % من الماء الجاهز التي تعادل 580 و420 و340 ملم موسم$^{-1}$ بالتتابع ,وأحتلت المعاملات الالواح الرئيسية، بينما أحتلت مستويات الهيومك 0 و 40 و 60 و 80 كغم هـ$^{-1}$ الالواح الثانوية. أظهرت النتائج عدم وجود فروقاً معنوية بين معاملة الاستنزاف 50% من الماء الجاهز ومعاملة أستنزاف 60% من الماء الجاهز في عدد الايام الى التزهير الذكري وعدد الاوراق والمساحة الورقية ودليلها و وزن المادة الجافة للنبات و معدل نمو المحصول، مما يدل على بأمكانية توفير كمية ماء تصل 1600 م^{3} هـ$^{-1}$ في الموسمين كليهما. أعطت نباتات معاملة الري عند أستنزاف 70 % من الماء الجاهز أقل متوسط لجميع الصفات المدروسة. حققت اضافة حامض الهيومك بمستوى 80 كغم هكتار$^{-1}$ اعلى زيادة معنوية في ارتفاع النبات وعدد الاوراق والمساحة الورقية ودليلها والمادة الجافة ومعدل نمو المحصول. كما أثر تداخل معاملات الهيومك والري معنوياً في صفات النمو ماعدا صفتي عدد الايام للتزهير الذكري وعدد الاوراق. لذلك نوصي في حالة محدودية المياه امكانية الري بأستنزاف 60 % من الماء الجاهزالتي تقدر 420 ملم، وامكانية اضافة الهيومك بمستوى 80 كغم هكتار$^{-1}$ لدوره في تقليل التأثيرات السلبية للاجهاد المائي في صفات النمو وحاصل المادة الجافة لنباتات الذرة الصفراء.

كلمات مفتاحية:، الري،الاستنزاف المائي، معدل نمو المحصول، الوزن الجاف.

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INTRODUCTION

Water stress is one of the determinants of crop growth, especially in dry and semi-arid environments. The plant response to water stress depends on metabolic efficiency, phenotype, growth stage and production capacity (9). Water stress causes damage for the various biochemical and physiological processes of cells such as respiration, carbonation, water absorption, ions, the transition of representative elements and the action of hormones, which is negatively reflected in plant growth (19). Several studies indicated that the water stress causes a decrease in the growth characters of corn, such as plant height, number of leaves, leaf area and accumulated dry matter. Al-Qaisi (4) indicated that the water stress caused reduction of leaf area and its index. The reason for that decreases was attributed to the effect of water stress to the period of growth and expansion of the leaves, which resulted in non-elongation of the cells. Irrigation after depletion of 75% of the available water gave the lowest average number of leaves, leaf area and dry matter13.20 leaf, 07343.5 cm^2 and 32.20 tons $^{-1}$ respectively, while irrigation with 50% of available water the highest average number of leaves and leaf area. Murtadha et al.(17) found that increasing the water stress when adding water after evaporation of 70 and 90 mm of water from the evaporation period reduced the number of days to anthesis, plant height, number of leaves and leaf area. Other Researchers (20,25,28), Found a declined in the average growth traits of corn plants due to the lack of moisture in the early stages of growth and this lack of water and nutrient absorption, especially which has an important role in the growth process and the accumulation of dry matter. The decrease in the number and leaves area leads to a decrease in the level of photosynthesis and consequently the low production of dry matter (15). The use of organic fertilizers has a positive effect on plant growth and productivity, and helps the plant to increase its activity and growth because it contains amino acids and nutrients as well as its role in reducing the plant nitrogen and water stress (12). Humic acid is one of these naturally produce organic acids, which is a humic substance derived from the decomposition of organic matter. Its addition to soil increases the plant absorption of nutrients as it acts as a medium to transfer nutrients from soil to plants, especially in the case of drought(18). Humic acid positively effects to the growth of plant as increases the permeability of cellular membrane and stimulates enzymatic reactions, improves cell division and elongation of cells, increases the production of plant enzymes and stimulate intracellular vitamins. This can be explained by the presence of Quinone group (21). The addition of humic acid in agricultural applications has direct effects through its various biochemical reactions in increasing cell membrane permeability (11). which include improved carbonation and respiration processes. The spraying corn plants with humic acids increased the nitrogen content of cells and this increased the division and elongation of the cells, which increased the plant height and diameter (7). Rezazadeh et al. (23) pointed out that the addition of humic acids to corn plants by interfering with mineral fertilizers increased dry weight and other growth parameters. Albahrani (1) revealed that the addition of humic acid to the soil at levels 0, 20 and 40 kg $^{-1}$ caused a significant increases in the average height of corn plant. He found pointed to the superiority of the level 40 kg $^{-1}$of Humic in dry weight increase of the vegetative part at the stage of which flowering total maturity with an increase of 28.1% and 31.1% in comparison with dry weight when treatment was not added. The objective of this study was to investigate the effect of humic acid under water stress on corn growth traits.

MATERIALS AND METHODS

Afield experiment was carried out during two fall seasons, 2016 and 2017. The first season was conducted at the Field of Field Crops Research Station of the Department of Agricultural Research, Abu Ghraib and the second season at the Experimental Field of The Department of Field Crops, College of Agriculture, University of Baghdad, Jadriya in order to investigate the effect of Humic acid and water stress on some growth characters of corn synthetic variety Fajr1. Randomized Complete Block Design within Split-plot arrangement was used. The study consisted of three treatments of irrigation (depleting 50, 60, and 70% of the available water), occupied as the main plots symbolized as I_1, I_2, and I_3 which were equivalent to 580, 420 and 340 mm irrigation water, respectively, the secondary factor was Humic acid levels at 0, 40, 60 and 80 kg. ha^{-1} in sub plots having the symbols of H_O, H_1, H_2 and H_3 respectively. The field was prepared and divided according to the design used. The experimental unit area was 3x3m consisted of three furrows 3m length and 0.75m between furrows and 0.20m between plants within the furrows, with plant population 66666 $plant.h^{-1}$. The distance between experimental units was 1m, to prevent water percolation, also 1.5 m distances were left between the main treatments and replicates. Urea fertilizer (46% N) was applied at rate of 174 $kg.ha^{-1}$ in two times, the first after 20 days of emergence and the second after 25 days of the first one. Superphosphate fertilizer (P_2O_5%) at rate of 109 $km.ha^{-1}$ was added during the soil preparation Insecticide added to the plants as Diazinon (10% effective ingredient) with rate of 6 $kg.ha^{-1}$ applied to the shoot-tips at the stage of 6 leaves and hand weeding was practicd manually when needed. Soil moisture was estimated through the relationship between the structural stress of the soil sample and the volumetric moisture content of the soil, through which the content of available was calculated as a result of the differences between the moisture content at the field capacity and the wilting point. The volumetric method was used to measure the soil moisture content by sampling the soil using the ocher tool, a day prior to irrigation and two days after irrigation at 20 and 40 cm respectively, then the samples were kept in aluminum cans, weighed, and dried in microwave oven, it was calibrated according to the method proposed by Zein (26). to dry the samples and then weighed again to estimate the moisture content, as the following equation:

$$Qv = Qw \times (\partial b / \partial w) \qquad .....(1)$$

Where:

Qv = Moisture content based on volume

Qw = Moisture content based on weight

∂b = Virtual density of soil

The irrigation was carried out by plastic pipes connected to a fixed discharge pump (2.1$L.sec^{-1}$) and equipped with scale as a meter to measure the amounts of water added to each experimental unit in order to control the calculation of the added water process based on the specified depletion of water content. Equal amount of water, 50% of the available water, was added to every plot when planting to ensure the field emergence; afterward, plants were irrigated according to the treatments of available water depletion percentage, 50, 60, 70%, in two depth 20 and 40 cm, where the water amounts of each irrigation for the treatments, I_1, I_2, and I_3 were 180, 216, and 252 L/9m^2 in the depth of 20cm, whereas they were 360, 432 and 504 L/9m^2 in the depth of 40 cm respectively. The quantity of water was added calculated according to the equation of Allen (3) as follows:

$$W = a.As\left(\frac{\%Pw^{F\,c} - \%Pw^{w}}{100}\right) \times \frac{D}{100} \qquad .....(2)$$

Where:

W= the water volume that should be added during irrigation (m^3)

a= the irrigated area (m^2)

As= virtual density (Mg $(m^3)^{-1}$)

$Pw^{F\,c}$ = percentage of soil moisture based on weight at the field capacity (post irrigation).

Pw^{w} = percentage of soil moisture percentage prior to irrigation

D= the soil depth according to the required root system (cm).

The observations for several growth characters were studied. Data were analyzed statistically according to the design, by using Genstat program, and the means were compared using the L.S.D at 5% probability level (24).

RESULTS AND DISCUSSION

Number of days to 50% of tasseling

Results in Table 1 shows significant differences among irrigation and humic level treatments for this trait in both seasons; however, the interaction effect was not significant. The plants of I_3 treatment (depleting 70% of the available water) recorded lowest period to 50% tasseling, 72.16 and 69.83 days respectively, for both seasons ; this treatment differed significantly from the other two irrigation treatments I_1 and I_2 (depleting 50 and 60% of the available water) recording 74.83 and 73.00 days in the first season and in the second season they were

74.66 and 71.83 respectively. The water stress increased the speed of physiological activity due to the increases of the temperature for the plants, and sheared flowering stage rapidly. Results in Table1. Show also that the number of days from planting to 50% tasseling increased with the increasing level of humic acid. The lowest times to reach this stage were 73.44 and 70.78 days for the corn plants. the longest period to reach this stage was 74.83 and 73.00 days for the H_3 humic acid treatment in the both seasons . The reason for the increases in the number of days to 50% tasseling was due to increases cell devotion, and prolong the life of green tissue (5). Non significant differences for interaction was found.

Table 1. Effect of irrigation and humic acid and their interactions on number of days to tasseling during (2016 upper and 2017 to lower) seasons.

irrigation	humic acid				Means
	H_0	H_1	H_2	H_3	
I_1	74.33 72.67	74.33 72.33	75.00 73.33	75.66 73.67	74.83 73.00
I_2	74.33 71.00	74.66 71.67	74.33 72.33	75.33 72.33	74.66 71.83
I_3	71.66 68.67	72.00 69.67	72.33 70.00	72.66 71.00	72.16 69.83
L.S.D %5			N.S N.S		0.75 1.98
Means	73.44 70.78	73.66 71.22	73.88 71.88	74.55 72.33	
L.S.D %5		0.41 0.64			

The symbolize as I_1, I_2, and I_3 for treatments of irrigation (depleting 50, 60, and 70% of the available waters. The H_O, H_1, H_2 and H_3 symbols for Humic levels are 0, 40, 60 and 80 kg ha^{-1}.

Plant height (cm)

Significant differences were found among water depleting and humic acid for the corn plant height (Table2). The irrigation treatment, I_1, produced the tallest plants in both seasons, (197.91 and 197.00) cm respectively, while the irrigation treatment, I_3, had the shortage plant, (177.83 and 171.00) cm for the two seasons respectively. The reduction in the plant height in the treatment I_3 was attributed to the shortage period, from planting to 50% tassling, during stem elongation, furthermore, the water stress decreased each of cell division and cell elongation, as a result of water potential decreases which related to the lack of water availability (13); moreover, reducing the number and area of the leaves affected through reducing the plant canopy that influencing the plant height negatively by inhibiting the auxin. These results came in agreement with the that found by Peng et al (20) and Zhao et al (28). The H_3 level of the Humic acid produced tallest plants (196.55 and 190.00 cm) respectively in relation to the average height of the plant at treatment H_0, which reached 180.22 and 176.77 cm. A significant interaction between two variables that response of corn plants to humic acid levels differed due to water stress. The ratio of plants height irrigation treatment after depletion of 50% of the available water (I_1) and the level of the humic 60 kg h^{-1} (H_3) was higher in the highest value (209.67 and 206.33) cm compared to the interaction of irrigation treatment after depletion of 70% of the available water (I_3) and (H_0), which had the lowest plant height (180.22 and 176.77) cm.

Table 2. Effect of irrigation and humic acid and their interactions on plant height(cm)during (2016 upper and 2017 to lower) seasons

Irrigation	humic acid				means
	H_0	H_1	H_2	H_3	
I_1	191.00	189.67	201.33	209.67	197.91
	188.67	193.33	199.67	206.33	197.00
I_2	179.33	180.00	191.33	194.00	186.16
	174.33	170.67	178.33	186.00	177.33
I_3	170.33	173.00	182.00	186.00	177.83
	167.33	168.00	171.00	177.67	171.00
L.S.D %5	5.28				4.38
	8.99				8.76
Means	180.22	180.89	191.55	196.55	
	176.77	177.33	183.00	190.00	
L.S.D %5		2.71			
		2.32			

The symbolize as I_1, I_2, and I_3 for treatments of irrigation (depleting 50, 60, and 70% of the available waters. The H_O, H_1, H_2 and H_3 symbols for Humic levels are 0, 40, 60 and 80 kg ha^{-1}

Number of leaves plant^{-1}

Results in Table 3 show significant differences among irrigation and humic level treatments for the number of leaves, while the interaction between two variables had not significant. The plant under I_1 produced highest number of leaves plant^{-1} for the two seasons 14.91 and 14.66 leaves respectively; but, it did not differed from the irrigation treatment I_2 in both seasons, while, the irrigation treatment I_3 produced the lowest average of this trait in both seasons, 13.58 and 13.33 leaves plant^{-1} respectively. The effect of water stress on the number of leaves plant^{-1} may be due to the negative effect of the shortage of the available water on the internodes elongation and thus led to a decrease in the rate of leaf emergence and growth (8), or due to the appearance decrease in plant height when treated with irrigation I_3 (Table 2) resulting in a reduction in the number of leaves. Water stress reduced the permanence of green leaves (17،20). The H_3 humic acid treatment produced the highest no.leaves plant^{-1} (15.44 and 10.15 leaf plant $^{-1}$) compared to the plant treated with H0 which produced the lowest 13.33 and 13.11 leaves Plant $^{-1}$ for the first and second seasons respectively. A non significant differences for the interaction was found.

Table 3. Effect of irrigation and humic acid and their interactions on on number of leaves during (2016 upper and 2017 to lower) seasons

irrigation	humic acid				means
	H_0	H_1	H_2	H_3	
I_1	14.33	14.66	14.66	16.00	14.91
	14.00	14.33	14.66	15.66	14.66
I_2	13.66	14.00	15.00	15.33	14.49
	13.33	13.66	14.33	15.00	14.08
I_3	12.00	12.66	14.66	15.00	13.58
	12.00	12.66	14.00	14.66	13.33
L.S.D %5	0.88				0.51
	0.98				0.88
Means	13.33	13.77	14.77	15.44	
	13.11	13.55	14.33	15.10	
L.S.D %5		0.53			
		0.45			

The symbolize as I_1, I_2, and I_3 for treatments of irrigation (depleting 50, 60, and 70% of the available waters. The H_O, H_1, H_2 and H_3 symbols for Humic levels are 0, 40, 60 and 80 kg ha^{-1}

Leaf area (cm^2)

The results in Table 4 indicate a significant differences among irrigation and humic level and their interaction in both seasons. The irrigation after depleting 50% of the available water (I_1) produced the highest leaf area in both seasons (6763 and 6436 cm^2, respectively); while the differences did not significant from the depleting 60% The plants under treatment of irrigation after depleting 70% of the available water produced the lowest of leaf area in the two seasons, (5364 and 5195 cm^2) respectively The reason for reducing the leaf area as a result of water stress which reduced number of days from planting to 50% tasseling in which caused leaf growth and elongation, in addition to the reduction in the number of leaves (Table 3) moreover, the water shortage led to the leaf area decline due to the reduction of photosynthesis (8). These findings have consisted with results of Al-Qaisi (4), Murtadha et al (17) and Peng et al (20) they found that exprosserat the corn plant to water stress reduced the leaf area. Results in Table 4. Shows that the leaf area was significantly differed by humic acid levels. The leaf area increased by 4.78%, 6.64%, 15.42%, 14.68%, 22.35% and 23.16% for levels H_1, H_2 and H_3 respectively compared with H_0 in both years. The increased in the leaf area when added humic acid is due to the role of the elements, which increased the vital functions of the plant cells and their storage similar to the growth regulators that are responsible for increasing the activity of the cell. Increase the rate of carbonation and this increases the leaf area of the plant (18). This results are consistent with the findings of AL.Khafaji (2) and Muhanna et al (16). The interaction between irrigation and humic acid was significant for this character. This reveals that the response of corn leaf area differed due to the water stress and humic acid. The plant at the interaction of I_1 and H_3 had highest value of the leaf area (7376 and 7155 cm^2) compared with the lowest value of the leaf area 4942 and 4730 cm^2 for treatment I_3 and H_0. This may be due to an increase in the number of leaves in the treatment of I_1 and H_3, which increased the leaf area of the plants of this treatment (Table 3).

Table 4. Effect of irrigation and humic acid and their interactions on leaf area(cm^2) during (2016 upper and 2017 to lower) seasons

irrigation	humic acid				means
	H_0	H_1	H_2	H_3	
I_1	6191	6235	7252	7376	6763
	5702	6214	6676	7155	6436
	5741	6464	6652	7302	6539
I_2	5382	5722	6121	6534	5939
	4942	4982	5570	5965	5364
	4730	4927	5339	5787	5195
I_3	401				326
	557				547
L.S.D	5624	5893	6491	6881	
%5	5271	5621	6045	6492	
Means					
		210			
L.S.D		209			
%5					

The symbolize as I_1, I_2, and I_3 for treatments of irrigation (depleting 50, 60, and 70% of the available waters. The H_O, H_1, H_2 and H_3 symbols for Humic levels are 0, 40, 60 and 80 kg ha^{-1}

Leaf area index

The results in Table 5 indicate a significant differences among irrigation and humic level and their interaction for the leaf area index. The depleting 50% of the available water (I_1) had the highest average for this trait in both seasons,(4.50 and 4.29 respectively) however, it was not differed significantly from the (I_2) of irrigation after depleting 60% of the available water, while the treatment (I_3) of irrigation after 70% of the available water had the lowest leaf area index (3.57 and 3.46) for both seasons respectively. The decreases in the leaf area index attributed to the reduction of the leaf area that negatively affected this index. These results agreement with result of Al-Qaisi (4), , Murtadha et al (17) and Peng et al (20) They found that available water shortage reduced the plant leaf area; thus this reduction reflected negatively on the leaf area index. The results in Table 5 show an increase in the value of the leaf area index with the increasing in the humic levels (Table 5). The H_3 produced the highest leaf area index(4.58 and 4.32) for both seasons, while the H_0 was the lowest leaf area index (3.74 and 3.51) for both seasons respectively. This result agreement with the result of AL.Khafaji (2) and Muhanna et al (16). The interaction between irrigation treatments and humic levels was significant. The interaction between irrigation treatment I_1 and H_3 fertilization treatment showed the highest leaf area index of (4.91 and 4.77) respectively.

Table 5. Effect of irrigation and humic acid and their interactions on leaf area index during (2016 upper and 2017 to lower) seasons

irrigation	humic acid				means
	H_0	H_1	H_2	H_3	
I_1	4.12	4.15	4.83	4.91	4.50
	3.80	4.14	4.45	4.77	4.29
I_2	3.82	4.30	4.43	4.86	4.35
	3.58	3.81	4.08	4.35	3.95
I_3	3.29	3.32	3.71	3.97	3.57
	3.15	3.28	3.56	3.85	3.46
L.S.D %5	0.26				0.21
	0.37				0.36
Means	3.74	3.92	4.32	4.58	
	3.51	3.74	4.03	4.32	
L.S.D %5		0.14			
		0.13			

The symbolize as I_1, I_2, and I_3 for treatments of irrigation (depleting 50, 60, and 70% of the available waters. The H_O, H_1, H_2 and H_3 symbols for Humic levels are 0, 40, 60 and 80 kg ha^{-1}.

Dry matter weight (gm)

Significant differences were found among irrigation and humic level and their interaction for dry matter weight (Table 6). The treatment of irrigation after depleting 50% of the available water (I_1) produced the highest dry matter(214.54 and 210.92 gm), in both seasons respectively. But, they did not different significantly from the irrigation after depleting 60% of the available water, while the irrigation after depleting 70% of the available water produced the lowest plant dry weight, 167.83 and 159.63 gm for both seasons recording. The decrease of the dry weight could be attributed to the effect of water stress on growth traits such as plant height, number of leaves, and leaf area where consequently affected the ability of plant to produce and accumulate dry matter. The results were agreement with those found by Zhao et al (28) , Zhang et al (27) and Aoda and Fattah (6). The average dry weight of the plants was affected significantly by the dose of hemic acid. H_1, H_2, and H_3 levels were produced (189.72, 182.50), (199.72, 192.33) and (213.95, 210.83) gm in both seasons respectively. The plants at the control treatment H_0 produced the lowest averages of (182.00 and 179.28 gm) for both seasons respectively. These results are agreement with Albahrani (1). The interaction between two variables was significantly affected (Table 6). where the irrigation treatment at the depletion of 50% of the available water I_1 and the level of H_3 produced highest dry weight of the plant (227.67and 229.50 gm).

Table 6. Effect of irrigation and humic acid and their interactions on plant dry matter(gm) during (2016 upper and 2017 to lower) seasons

irrigation	humic acid				means
	H_0	H_1	H_2	H_3	
I_1	204.83	209.17	216.50	227.67	214.54
	198.67	203.50	212.00	229.50	210.92
I_2	189.83	201.83	207.83	227.17	206.67
	194.33	196.83	203.00	218.50	203.17
I_3	151.33	158.17	174.83	187.00	167.83
	144.83	147.17	162.00	184.50	159.62
L.S.D %5	11.48				11.66
	9.08				9.02
Means	182.00	189.72	199.72	213.94	
	179.28	182.50	192.33	210.83	
L.S.D %5		6.20			
		5.70			

The symbolize as I_1, I_2, and I_3 for treatments of irrigation (depleting 50, 60, and 70% of the available waters. The H_O, H_1, H_2 and H_3 symbols for Humic levels are 0, 40, 60 and 80 kg ha^{-1}.

Crop growth rate (gm.day^{-1})

Results in Table 7 reveal significant differences among irrigation, humic level and their interaction for crop growth rates. The crop growth rates were decreased as water stress increased in both seasons. The plants at the treatment of irrigation after depleting 50% of available water produced the highest averages the crop growth rate 2.87 and 2.89 gm.day^{-1} in the both seasons respectively, but the treatment declined to 2.33 and 2.28 gm.day^{-1} when the irrigation 70% of available water was applied. The decreases in the crop growth rate under the influence of water stress was due to the reduction in the period from planting to 50% tasseling resulting in reducing photosynthesis products. The addition of the humic acid significantly increased the growth rate of the crop by increasing the levels of the humic. The plants at the level of H_3 achieved the highest 2.87 and 2.91with an increase of 15.90 and 15.30 % compared with the treatment of non-addition H_0. This increase may be due to the fact that the synthesis of the humic acid plays a role in the formation of the cauliflower compounds, which in turn increases the nutrient depletion through the cellular membranes and thus facilitates the transfer of nutrients into the plant. The amino acids involved in the synthesis of organic acids play a role in the formation of proteins, this result came close to the results of Gomaa etal.(14). There was a significant interaction between the irrigation and the humic levels. The increased response with increasing in the irrigation water and the levels of the humic. The highest average rate was 3.01 and 3.12 in the irrigation treatment I_1 (irrigation treatment after depletion of 50% available water) and the H_3 level of the seasons respectively The mean was 2.11and 2.11when I_3 was mixed and the H_0 was not added to the seasons in sequence

Table 7. Effect of irrigation and humic acid and their interactions on crop growth rate(gm day^{-1}) during (2016 upper and 2017 to lower) seasons

irrigation	humic acid H_0	H_1	H_2	H_3	means
I_1	2.76	2.81	2.89	3.01	2.87
	2.73	2.81	2.89	3.12	2.89
	2.55	2.70	2.80	3.02	2.77
I_2	2.74	2.75	2.81	3.02	2.83
	2.11	2.20	2.42	2.57	2.33
	2.11	2.11	2.31	2.60	2.28
I_3	0.15				0.14
	0.16				0.15
L.S.D	2.47	2.57	2.70	2.87	
%5	2.53	2.56	2.67	2.91	
Means					
		0.04			
		0.05			
L.S.D					
%5					

The symbolize as I_1, I_2, and I_3 for treatments of irrigation (depleting 50, 60, and 70% of the available waters. The H_O, H_1, H_2 and H_3 symbols for Humic levels are 0, 40, 60 and 80 kg ha^{-1}

Conclude from this study that addition a levels of humic acid to the soil improved the plant's tolerance to water stress by giving the highest values of the studied qualities compared to the treatment without addition, indicating the possibility of maintaining the growth of maize in case of lack of water available.

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