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Effect of Phases of Adding Humic Fertilizer and Planting Dates on Some Growth Characteristics of Maize

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Summery: A field experiment was carried out for the spring and autumn seasons 2020 in Rawa district. The first factor occupied the stages. Addition of humic acid and the second planting dates. I used a randomized complete-plot design (RCBD) with split-plot arrangement with three replications to see the effect of the phases of humic acid addition (S0, S1, S2 and S3) and planting dates (1 D, D2 and D3) in Some of the characteristics of vegetative growth and the results exceeded the treatment S3 in (plant height, leaf area and the ear height) as it achieved 200.28 cm, 591.1 cm2, and 117.39 cm respectively in the spring season, but in the autumn season, treatment S2 surpassed in (the fewest days from emergence until 50% tasseling and silking, in the characteristic of plant height and ear height) gave 45.78 days, 52.00 days, 232.66 cm and 136.20 cm respectively. Treatment S1 also outperformed the leaf area, as it gave 836.1 cm2. The planting dates had a moral effect in most of the studied characteristics in the two seasons, in the spring season the date D3 exceeded in (the fewest days from emergence of up to 50% tasseling and silking), as it gave a day, 74.42 days, respectively, and the date D2 exceeded (an increase in characteristic ear height) as it gave 118.26 cm, but in the autumn season it exceeded the date D3 in (the fewest days from emergence of up to 50% tasseling and silking, recipe for plant height and the ear height) as it gave 44.50 days, 49.58 days, 238.90 cm, 141.59 Cm respectively, as the interaction had a significant effect on most of the studied traits. In the spring season, the parameters D2, S3 and D2, S2 and D1, and S2 were distinguished in the characteristic of(plant height ,leaf area and ear height), respectively, as it gave 203.33 cm. 635.6 cm2, 120.53 cm, respectively, but in the autumn season, the treatment and D3 and S1 were distinguished in (plant height and ear height) as it gave, 242.43 cm and 145.33 cm, respectively, while treatment D3 and S2 were distinguished in (the fewest days of Emergence of up to 50% tasseling), given 43.67 days.

Key words: humic acid, planting dates, corn

Zea mays L. is one of the important cereal crops that belong to the Poaceae family, as it ranks third in terms of cultivated area and production after the wheat and rice crops, Taha et al, (2019). The cultivated area in Iraq for the year 2016 was (76,000) hectares. With an average production of (3,416) $Mg.H^{-1}$Al-Halfi and Tamimi, (2018), Maize grains contain (81%) carbohydrates and (10.6%) crude protein, (4.6%) oil and (2%) ash, and they also contain vitamin E, B1, B2 Lafta and Yehia, (2019), so the importance of this crop lies in its multiple uses as it is used as food for humans in addition to its entry into many industries where it is used as green fodder or silage in livestock feeding. It can also be used as poultry feed in the concentrated diet as it is included in the medical uses of some diseases as a treatment for kidney stones. And reduce blood pressure and sugar, as leaves and stems are

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used in the manufacture of dyes and papers and the biofuels industry as a substitute for car fuel Hussein (2019). Maize is a depleted crop due to its high ability to absorb nutrients in large quantities during the growing period Al-Kartani (2018). Therefore, the thought was to use alternatives to chemical fertilizers as the overuse of them leads to the occurrence of environmental pollution as a result of disturbing the carcinogenic environmental balance Al-Kartani (2018). Those interested in the agricultural field to provide the necessary nutrients for the plant in appropriate quantities and times to increase the yield per unit area, Tajalddin and Barakat (2017), Among the techniques that are used as an alternative to chemical fertilizers is the use of organic fertilizers, including humic acid Ahmed and Aziz (2019), which is a humic substance consisting of many compounds of high molecular weights united with each other and with an unknown chemical composition and contains large numbers of active groups, Muhanna et al. (2015), and it is produced from chemical and biological processes in the soil, which works to improve the chemical, physical and biological properties in it, as it provides the necessary nutrients for the plant due to its ability to mix many of them and increase its readiness for the plant in addition to increasing the ability of the soil to retain water as well as its ability to stimulate societies Bioassays and their growth in soil Khan et al. (2019), It also works to increase the readiness of trace elements such as iron, zinc and manganese in the soil, as it works to chelate them and prevent them from combining with the phosphate group to form insoluble compounds Al-Aniet al (2018). It greatly affects the length of the flowering period of Al-Saadoun (2006), and the time of planting is one of the foundations on which the cultivation of maize is based, due to the coincidence of appropriate temperatures with the different stages of plant growth, Yunus and Hassan (2018), As plants in the initiation phase are exposed to cold when planting early in the spring season and to high temperatures when flowering in late planting, which negatively affects germination, pollination and fertilization processes, and thus leads to a decrease in the initial yield Al-Badri (2019) , but in the autumn season, the seedlings are exposed to heat High humidity during early sowing, and rotting seeds when planting is late. Therefore, this study came to determine the best stage for adding organic fertilizer and the best planting date to give the best characteristics of vegetative growth, reduce pollution and reduce the rate of rot and self-germination in the seeds.

Materials and methods:

A field experiment was carried out in the spring and autumn seasons of 2020 in Rawa district, located at longitude : E ° 41.57 Latitude: N ° 34.46 and at a height of 150m above sea level, to study the effect of the stages of adding humic acid and planting times on the growth and yield of maize, Varietie (5018), the first factor The phases of adding humic acid and the second planting times , RCBD was used in split-plot arrangement with three replications, The main plot included the planting times, which were denoted by the symbol D1, D2, and D3 in the sequence (1 March, 15 March and 1 April) for the spring season and (1 July, 15 July, 1 August) for the autumn season, while the secondary plot (sub-plot) included the stages of adding organic fertilizer (Humic) at a rate of 24 $kg.h^{-1}$. Taha et al, (2019), which were represented in four stages: S0 without addition (control), S1 addition at the stage of the fourth leaf is complete and real, and S2 addition at the stage of the eighth leaf is complete and true, and S3 addition at the stage of the twelfth leaf and before flowering is complete and true, where it was added by dissolving fertilizer with (3) liters of distilled water a day before

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adding to each experimental unit and adding it by making an incision next to the planting line and covering it with field soil. Random samples were taken from the field soil before planting at three different depths (0-30) cm to study some Its chemical and physical properties have been placed in Table (1).

Table (1) shows the chemical and physical characteristics of field soil

Characteristic	Unit	Value	Characteristic	Unit	Value
Sand	%	29	Ca^{++}	$Mg.L^{-1}$	425
Silt	%	51	Mg^{+}	$Mg.L^{-1}$	198
Clay	%	20	Na^{+}	$Mg.L^{-1}$	520
Bulk density	$g.\ cm^{-1}$	1.45	K^{+}	$Mg.L^{-1}$	39.8
EC 1: 1 (1: 1 extract)	$dc.m^{-1}$	2.87	CL^{-1}	$Mg.L^{-1}$	995
PH		7.39	So_4^{-2}	$Mg.L^{-1}$	929
Caco3 (Lime)	%	26.2	Hco3	$Mg.L^{-1}$	418
Organic Matter O.M	%	1.16	No3	$Mg.L^{-1}$	45
Available Nitrogen	$Mg.kg^{-1}$	69			
AvailablePhosphorous	$Mg.kg^{-1}$	12.3	Available Potassium	$Mg.kg^{-1}$	168

Soil mixed according to the tissue triangle (alluvial mixture)

Table (2) analysis of humic fertilizer.

N%	P%	K%	O.M%
6.58	0.03	0.005	37.08

The experiment land was plowed by two perpendicular plows, then it was flattened, and after the completion of the leveling and adjustment operations, the experiment land was divided into experimental units of an area of (12) m^2 with dimensions (3 × 4) m, where the experimental unit was planted on the lines of the distance between one line and another 60 cm and the distance between one and another 25 cm to obtain At a plant density of 66666 plants / hectare, the duplicates were isolated from each other with a distance of 1.5 m and the secondary panels were isolated from each other with a distance of 1 m to prevent the leakage of fertilizer between treatments, add the ready-made compound fertilizer ($N:P_2O_5:K_2O$) at a concentration of (15:15:15) in one batch before planting so as not Interferes with the addition of organic fertilizer at a rate of (400) $kg.H^{-1}$, The addition process was carried out by spreading the compost and covering it with the field soil, the planting was done by hand according to the dates of planting prepared in a schedule by placing (2-3) seeds in the gora at a depth of 3-5 cm, after which the experiment was watered and then the field was patched to complete the germination after a week of emergence then the plants were loosened to one plant in the gora at the third leaf stage, the test ground was planted manually three times during the season until the plant height, the granulated diazinon pesticide was used at a concentration of (10%) according to the recommendation to combat the stem borer insect, where it is added by feeding the growing top of the plant by the amount of (6) $Kg.H^{-1}$, with two batches, the first is protective for the plant in the third leaf stage and the second is

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precautionary, after the plant reaches the sixth leaf stage, the spring season plants planted on (1 March, 15 March,1 April) On (16 July, 21 July, and 28 July) respectively, I harvested the plants of the autumn season planted on (1 July, 15 July, and 1 August) on (20 October, 31 October and 20 November) respectively. Ten plants were taken from each experimental unit. The following characteristics were averaged:

1 -The number of days from emergence up to 50% tasseling/ day.

2-The number of days from emergence up to 50% silking/ day.

3- Plant height: measured from the soil surface to the end of the last node of the stem under the male inflorescence AL-Dulaimi (2015).

4- leaf area / cm2: measured by multiplying the maximum length of the leaf x the maximum width of the leaf under ear x 0.75 Aliu et al. (2010).

5- ear height/ cm: It was measured from the soil surface to the node carrying the main upper ear, Abdel-Amir and Hadi (2018).

Statistical analysis: The data were analyzed statistically according to the ready-to-use Genstat program for statistical analysis. The arithmetic averages were compared using the least significant difference L.S.D with a probability level of 0.05.

Results and Discussion

1 -The number of days from its emergence up to 50% tasseling:
The results of Table (3) showed that treatment S2 required the lowest average number of days to reach 50% tasselingof (45.78) days compared to treatment S0, which required the highest average number of days (48.00) days in the autumn season. The reason may be attributed to Humic acid and its nutritional elements that cause an increase in the speed of growth due to an increase in chlorophyll, which leads to the accumulation of dry matter and thus early male flowering, Taha et al. (2019), and these results agree with El-Mekser et al.(2014) .

The same table also showed that the date D3 took the lowest average number of days to reach 50% tasseling, which reached (66.67 and 44.50) days for the spring and autumn seasons respectively, compared to date D1, which took the highest average number of days (77.17 and 48.00) days for the spring and autumn seasons, respectively. Consecutively, and the reason may be due to lower temperatures when planting at late dates and thus speeding up the flowering process compared to early dates with higher temperatures that favor growth, Akinnuoye-Adelabu and Modi (2017), and this result is consistent with the results of Ali et al. (2018).

The same table also shows the presence of a significant effect of the interaction between the stages of adding humic fertilizer and the planting dates. In the autumn season, the treatment D3, S2 took the lowest average number of days to reach 50% tasseling, which reached (43.67) days compared to the treatment D2, S0, which took the highest average number of days. It reached (50.00) days, and the reason may be attributed to the increased absorption of nutrients by the plant during the active growth phase, the availability of appropriate

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temperatures when planting at the late dates, the increase in dry matter accumulation, and thus the acceleration of flowering.

Table (3) shows the effect of the stages of adding humic fertilizer and planting dates and the overlap between them on the number of days from emergence up to 50% tasseling for the spring and autumn seasons / day.

Spring season						Autumn season				
Date	Humic stages				Means of date	Humic stages				Means of date
	S0	S1	S2	S3		S0	S1	S2	S3	
D1	76.33	76.33	77.33	78.67	77.17	48.33	48.33	47.00	48.33	48.00
D2	74.00	72.00	72.67	73.33	73.00	50.00	46.67	46.67	48.33	47.92
D3	66.67	66.33	66.00	67.67	66.67	45.67	44.33	43.67	44.33	44.50
Means of humic stages	72.33	71.56	72.00	73.22		48.00	46.44	45.78	47.00	
L.S.D 0.05	D	S	D*S			D	S	D*S		
	2.154	N.S	N.S			0.681	0.681	1.129		

Days from emergence up to 50%silking/ day:

Table (4) shows that treatment S2 required the lowest average number of days to reach 50% silking, which reached (52.00) days compared to treatment S0, which required the highest average number of days (53.44) days, and the reason may be attributed to the fact that treatment S0 took the highest average The number of days from emergence up to 50% silkingand thus the number of days from emergence increased to 50% silking, and this result is consistent with the results of Hassan et al.(2019) .

The same table also indicated that the date D3 took the lowest average number of days to reach 50% silking, which reached (74.42 and 49.58) days for the spring and autumn seasons respectively, compared to date D1, which took the highest average number of days (83.33 and 55.75) days for the spring and autumn seasons, respectively. Consecutively, and the reason may be due to the short period it took for D3 to reach 50% tasseling and thus early silking, and this result is consistent with the results of Akinnuoye-Adelabu and Modi (2017).

Table (4) shows the effect of the stages of adding humic fertilizer and planting dates and the overlap between them on the number of days from emergence up to 50% silkingfor the spring and autumn seasons / day.

Spring season						Autumn season				
Date	Humic stages				Means of date	Humic stages				Means of date
	S0	S1	S2	S3		S0	S1	S2	S3	
D1	83.67	82.67	83.00	84.00	83.33	55.67	55.67	55.33	56.33	55.75

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D2	79.67	78.00	78.67	79.33	78.92	54.33	51.67	51.67	53.00	52.67
D3	74.67	73.67	74.00	75.33	74.42	50.33	49.00	49.00	50.00	49.58
Means of humic stages	79.33	78.11	78.56	79.56		53.44	52.11	52.00	53.11	
L.S.D 0.05	D	S	D*S			D	S	D*S		
	4.83	N.S	N.S			0.73	0.68	N.S		

Plant height / cm:

Table (5) outperformed treatment S3 and S2 in the spring and autumn seasons respectively, as it gave the highest average plant height of (200.28 and 232.66) cm for the spring and autumn seasons respectively, compared to treatment S0, which gave the lowest average plant height of (191.21 and 219.46) cm. For the spring and autumn seasons respectively, and perhaps the reason for this is that the nitrogen provided by humic acid is readily absorbed by the plant, which helps in cell division and elongation and increase the length of phalanges, and thus an increase in plant height Muhanna et al. (2015), and this result is consistent with what Melo found de et al (2015) and Attia et al.(2013)

The same table also indicated the superiority of date D3 in this characteristic, as it achieved the highest average plant height of (238.90) cm compared to date D1, which gave the lowest average plant height of (220.58) cm for the autumn season. Temperatures and high relative humidity Al-Badri (2019), and these results are consistent with the findings of Beiragi et al . .(2011)

The same table also showed a significant effect of the interaction between the stages of adding humic fertilizer and planting dates on the characteristic of plant height for the spring and autumn seasons. In the spring season, the treatment D2, S3, which achieved the highest average plant height of (203.33) cm, was distinguished compared to the treatment D3, S0, which gave the least. The average plant height reached (189.27) cm, but in the autumn season, the treatment D3 and S1 exceeded, as it achieved the highest average plant height of (242.43) cm compared to the treatment D1, S0, which gave the lowest average plant height of (211.03) cm.

Table (5) shows the effect of the stages of adding humic fertilizer, planting dates, and the overlap between them on the characteristic of plant height for the spring and autumn seasons: (cm).

Spring season						**Autumn season**				
Date	**Humic stages**				**Means of date**	**Humic stages**				**Means of date**
	S0	**S1**	**S2**	**S3**		**S0**	**S1**	**S2**	**S3**	
D1	191.10	194.93	201.70	197.17	196.23	211.03	227.1	229.47	214.73	220.58
D2	193.27	194.33	201.87	203.33	198.20	212.63	228.33	226.77	220.77	222.12
D3	189.27	194.93	195.20	200.33	194.93	234.70	242.43	241.73	236.73	238.90
Mean	191.2	194.7	199.5	200.2		219.4	232.6	232.6	224.0	

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s of humic stages	1	3	9	8		6	2	6	8
L.S.D 0.05	D	S	D*S			D	S	D*S	
	N.S	2.333	4.04			3.927	2.11	3.654	

Leaf Area (cm^2):

The results of Table (6) indicated the superiority of the two treatments S3 and S1 in the spring and autumn seasons respectively. In the spring season, treatment S3 achieved the highest average leaf area of (590.1) cm^2 compared to the comparison treatment S0, which gave the lowest average paper area of (528.8) cm^2. In the autumn season, treatment S1 achieved the highest average leaf area of (836.1) cm^2 compared to treatment S0, which gave the lowest average for the trait of (724.1) cm^2, and the reason may be attributed to the fact that humic acid has an effective role in activating biological processes inside the plant, such as cell elongation and division in addition. To activate hormones and enzymes that help to manufacture nutrients inside the plant and thus increase the leaf area, Abkeh and Asadi (2017), and this result is consistent with what Bilal and others (2016) and Azeem et al. (2015) have reached.

The same table also showed the significant effect of the interaction between the stages of adding humic fertilizer and the planting dates, as the treatment D2, S2 was distinguished in the spring season as it achieved the highest average leaf area of (635.6) cm^2 compared to the treatment D3, S0, which gave the lowest average leaf area of (482.6). Cm^2.

Table (6) shows the effect of the stages of adding humic fertilizer, planting dates, and the overlap between them on the characteristic of the leaf area of the spring and autumn seasons / cm^2.

	Spring season					**Autumn season**				
Date	**Humic stages**				**Means of date**	**Humic stages**				**Means of date**
	S0	**S1**	**S2**	**S3**		**S0**	**S1**	**S2**	**S3**	
D1	533.8	603.6	593.9	577.1	577.1	716.8	838.9	843.0	732.9	782.9
D2	570.1	575.9	635.6	634.9	604.1	683.5	811.4	791.2	767.8	763.5
D3	482.6	588.2	514.2	558.4	535.9	772.1	858.2	843.5	748.9	805.7
Means of humic stages	528.8	589.2	581.2	590.1		724.1	836.1	825.9	749.9	
L.S.D 0.05	D	S	D*S			D	S	D*S		
	N.S	31.34	54.28			N.S	29.86	N.S		

Ear height/ cm:

The results of Table (7) showed the superiority of the two treatments S3 and S2 in the spring and autumn seasons respectively, as treatment S3 achieved the highest average increase in the

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ear height in the spring season, which reached (117.39) cm, compared to treatment S0, which gave the lowest average for the characteristic of (106.40) cm. The autumn season, treatment S2 achieved the highest average height of the ear height which reached (136.20) cm, compared to treatment S0, which gave the lowest average for the characteristic was (124.01) cm. The reason may be that humic acids lead to the formation of new cells in the growing apex as a result of the humic acid provided by Nitrogen ready to be absorbed and thus increased plant height and Archaea chief Muhanna et al. (2015), and this result is consistent with what El-Shafey and Zen El-Dein (2016) found.

The same table also showed the superiority of dates D2 and D3 in the characteristic of the ear height for the spring and autumn seasons respectively, in the spring season the highest average height of the ear height at the date D2, which reached (118.26) cm compared to date D3, which gave the lowest average height of ear height which reached (106.87). Cm. In the autumn season, the highest height of the ear height was (141.59) cm at the date D3, while the lowest height of the ear height was at the date D1, which reached (123.70) cm. The reason may be attributed to the superiority of dates D2 and D3 in the characteristic of plant height. In the spring and autumn seasons respectively, although it was not significant in the spring season, and this result is consistent with the findings of Al-Mashhadani (2010) and Al-Saadoun.(2006)

The same table also showed the significant effect of the interaction between the stages of adding humic fertilizer and the planting dates in the spring and autumn seasons in the characteristic of the height of the ear height. In the spring season, treatment D1, S2 achieved the highest average height of the ear heightof (120.53) cm compared to the treatment D3, S0, which gave the lowest The mean of the trait was (95.20) cm, but in the autumn season, the treatment D3 and S1 surpassed, as it gave the highest average for the trait of (145.33) cm compared to the treatment D1, S0, which gave the lowest average for the trait of (117.37) cm.

Table (7) shows the effect of the stages of adding humic fertilizer, planting dates, and the overlap between them on the height of the ear heightfor the spring and autumn seasons / cm.

Spring season						Autumn season				
Date	Humic stages				Means of date	Humic stages				Means of date
	S0	S1	S2	S3		S0	S1	S2	S3	
D1	107.73	118.03	120.53	117.1	115.85	117.37	128.2	129.9	119.33	123.7
D2	116.27	116.57	120.27	119.93	118.26	119.2	132.2	133.97	122.57	126.98
D3	95.2	112.77	104.37	115.13	106.87	135.47	145.33	144.73	140.83	141.59
Means of humic stage	106.4	115.79	115.06	117.39		124.01	135.24	136.2	127.58	

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s				
L.S.D 0.05	D	S	D*S	
	4.826	2.871	4.972	

D	S	D*S	
2.825	1.693	2.933	

Conclusion

In the spring season, the phase of adding humic fertilizer S3 outperformed in the characteristic (plant height, leaf area, and ear height, but in the autumn season, the treatment S2 surpassed in the least number of days from emergence of up to 50%tasseling and silking, plant height, and ear height. In the spring season, the date D3 exceeded in the fewest days from emergence, up to 50% tasseling and silking, while the date D3 exceeded in (the fewest days from emergence of up to 50% tasseling and silking, plant height and ear height.

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