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Role of Humic Acid and Some Spraying Treatments in Improving Vegetative Growth Parameters, Chemical Components of Leaves and Yield of Hot Pepper Plants (*Capsicum annuum* L.) Planted in Unheated Plastic Houses Conditions

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Abstract. The experiment was implemented through the winter agricultural season 2020-2021 in one of the unheated greenhouses with dimensions (9 x 50) m and an area of 450 m² following to the fields of the department of horticulture at the college of agriculture and marshes - Dhi Qar University, south of Iraq, with the aim of research the impact of adding humic acid, spraying sevsral treatments, on vegetative growth parameters ,chemical components of leaves and yield of two kind hybrids of hot pepper plants (Barbarian F1and Kizil F1).

Experiment included 30 factorial treatments which were the possible combinations of two hybrids(Barbarian F1and Kizil F1), three proportions of humic acid 0, 1, 2 g. l^{-1} and five foliar spray treatments (aqueous extract of jujube leaves at a proportion (75) g. l^{-1}, aqueous extract of pomegranate peels at a proportion of 5 ml. l^{-1}, calcium at a proportion of 1.5 ml. l^{-1}, arginine acid 200 mg. l^{-1} in addition to control treatment (spraying with distilled water only). Factorial experiment was designed out according to the split-split plot design in R.C.B.D with three replicates. The results were analyzed by the analysis of variance and mean values were contrast using the Revised Least Important Difference Test at 0.05 probability. Results appear that the Barbarian F hybrid superiority on plant height, leaf area, chlorophyll and nitrogen,. Adding humic acid at the proportion of 2 g. l^{-1} led to important raise in the plant height, the proportion of total chlorophyll, while the proportion of 1 g. l^{-1} caused an increment in the percentages of nitrogen, the proportion of total chlorophyll and the yield per plant. Spraying arginine acid 200 mg. l^{-1} led to raise the proportion of total chlorophyll, whereas the treatments of arginine acid 200 mg. l^{-1} and calcium at a proportion of 1.5 ml. l^{-1} were the best in growing the leaf area. The application of extract of pomegranate peels at a proportion of 5 ml. l^{-1} gave the highest yield per plant.

Keywords: Hot Pepper, Humic Acid, Nitrogen, Extract of Pomegranate Peels, Total Chlorophyll, Arginine.

INTRODUCTION

Hot pepper (*Capsicum frutescens* L.) one of the important summer crops of the Solanaceae family, it needs a moderate climate that tends to heat and does not tolerate cold to a large extent, while frost leads to the decimation of plants, that is why tropical countries are famous for its production, such as India, Indonesia, Myanmar, Bangladesh, Pakistan and Thailand (FAO, 2009).

The importance of organic matter is due to its function in the chemical effect of most of the elements in the soil through its active compounds (fulvic and humic acids). These compounds have the ability to preserve elements in a chelating form in the soil. The function of organic fertilizers is due to Increasing the efficiency of vegetative and flowering growth indicators, which is due to their function in adding major and minor minerals to plants, as well as treating the physical, chemical and biological properties of the soil, which in turn encourages the raise of root growth and raise the readiness of nutrients for plants in addition to provides a suiTABLE environment for increasing secondary roots and diameter (Magdoff and Weil, 2004; Taain *et al*.,2021).

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The importance of humic acid results from increasing its fertility in the soil for its function in reforming soil properties and treating it as chelating materials, the ability to retain water and the chemical representation of clay components of the mineral and organic materials in addition to the exchange capacity of positive ions important in soil improvement (Selim and Mosa, 2012**;**AL-HAMADY *etal*.;2020).

Al-Moussawi (2015) studied the addition of humic acid at three levels (1, 2, 3) ml.l^{-1} in addition to the control treatment to pepper plants planted in unheated greenhouses and appear that the level of addition of humic acid 1 ml.l^{-1} was superior in giving the highest height of the plant reached 45.5 cm., while the level of 2 ml. l^{-1} gave the highest proportion of chlorophyll at 65.2 SPAD.

The current global trends aim to search for everything that is natural and non-industrial as it is essential in preserving nature or controlling the absence of any collateral damage to health. Many studies and research have confirmed that the use of plant extracts has clear effects in improving the indicators of vegetative and floral growth and the yield of many plants. This is cause to the effect that the plant extract have many natural chemical compounds, which are characterized by their qualitatively and quantitatively different types, plant parts, age stages of plant parts from which plants are extracted, and the environmental influences that plants have been exposed to (Grimstad, 1995 ;Hussein *et al*.,2014 ; Taain *et al*.,2017).

Amino acids play functions in many biological processes, and their importance and effectiveness lies in all stages of plant growth. In addition to being an essential component of proteins, they are building materials for important compounds such as nucleotides, porphyrins and enzymes. The addition of amino acids by spraying on the vegetative part or with irrigation water is easily absorbed by the leaves or roots, which play major function in growthing of the plant and also works to encourage plants to control environmental stresses as well as their direct impact on the fruit ripening process, and the molecules responsible for the taste (McCarthy *et al*., 1990, Hassan, 2010).

Calcium salts are used to raise the firmness of fruits and to treat many of the physiological disorders by controlling decay because the function of calcium in building the cell wall, activating the process of cell division and enzymes (Taain, 2011).

The current study was conducted to investigate the effect of ground addition of humic acid and application of some spraying treatments on the vegetative growth parameters and yield of two hybrids of hot pepper grown in unheated plastic houses.

MATERIALS AND METHODS

The research was carried in the winter agricultural season 2020-2021 in one of the unheated greenhouses with size (9 x 50) m and an area of 450 m² following to the ground of the department of horticulture at the college of agriculture and marshes - Dhi Qar University. The following TABLE shows some physical and chemical properties of plastic house soil and irrigation water used.

TABLE 1. Some of physical and chemical properties of some of plastic house soil and irrigation water used.

Type of Analysis	Unit of Measure	Soil	Irrigation Water	Method
EC	ds.m^{-1}	4.9	4.5	Page *et al*. (1982)
PH	----	7.68	7.60	
Total nitrogen	mg. kg $^{-1}$	16.4		
Ready phosphorous	mg. kg $^{-1}$	10.45		
Ready Potassium	meq . l^{-1}	25.2		
Organic matter	g.kg $^{-1}$	10.11		
Percentage of clay	%	41.2		Black (1965)
Percentage of silt	%	11.3		
Percentage of sand	%	49.8		
Soil texture	---	sandy clay		

The soil of the plastic house was plowed perpendicularly, then it was smoothed, leveled and divided into six lines with 36 m length, 40 cm width, and the distance between one line and another was 50 cm. The seedlings of chili pepper, Barbarian F1 and Kizil F1 cultivars, were planted in the plastic house on 15/10/2020 and all the processes using in the production of this crop grown in plastic greenhouses were conducted. A humic acid fertilizer was prepared at two proportions (1 and 2 g l^{-1}) in addition to the control addition , aqueous extract of jojobe leaves at 75 g l^{-1} , aqueous extract of pomegranate peel at 5 g L^{-1} , calcium solution at 1.5 ml. l^{-1} and arginine acid at 200 mg l^{-1}.

A split-split plot design was designed out, according to a randomized complete plot design (R.C.B.D.) with three replications (Al-Rawi and Khalaf Allah ,1980). The effect of two hybrids within the main plot and is symbolized by (V), so it is V1 for the first hybrid Barbarian F1 and V2 for the second hybrid Kizil F1, the second factor represents the humic acid within the sub-plot and is symbolized by (H) and with three levels of H0 for control (without fertilization) , H1 proportion of 1 g l^{-1} and H2 proportion of 2 g l^{-1} and the third factor within the sub-sub-plot represents the effect of spraying with the following treatments aqueous extract of jujube leaves at a proportion (75) g. l^{-1} symbolized by S1 and spraying with aqueous extract of pomegranate peels at a proportion of 5 ml. l-1 and symbolized by S2 and spraying with calcium at a proportion of 1.5 ml. l- 1 symbolized by S3 and spraying with arginine acid 200 mg. L-1 and symbolized by S4 In addition to comparison(addition with distilled water only) and symbolized by S0, thus the number of experimental units.

The number of experimental units was 90 (Al-Rawi and Khalaf Allah ,1980) and the following parameters were determined.

Plant height (cm), the leaf area (m^2. $plant^{-1}$), chlorophyll proportion of leaves (mg.100 g^{-1}) which determined according to the method described in Goodwin (1976). The percentage of nitrogen was determined in the digested samples using the Micro Kjeldhal apparatus as described in Page *et al*. (1982).

RESULTS AND DISCUSSION

Plant Height (cm)

Results of **TABLE (2)** appeared that the hybrid had a excellence on plant height, where the plants of Barbarian F1 hybrid outperformed the plants of the Kizil F1 hybrid in plant height with percentage raise of 5.89%.

The addition of humic acid to the soil had a important effect on the plant height, as the plants grown in the soil to which the humic acid was added at a proportion of 2 g.l^{-1} importantly raised the plant height contrast to the control plants and plants grown in the soil to which the acid was added at a proportion of 1 g. l^{-1} with percentage raise quantitiesed to (19.83 and 4.98)%, respectively.

The spraying treatments used had no excellence on the plant height of pepper plants.

The binary overlap between the hybrid and the addition of humic acid to the soil had a important effect on the plant height, when the plants of the Kizil F1 hybrid that were grown in the soil to which the humic acid was added at a proportion of 2 mg.l^{-1} recorded the highest plant height of 118.40 cm, while the minimum plant height was recorded in the same hybrid plants untreated with humic acid (0 mg.l^{-1}) , which was 84.83 cm.

As for the binary interplay between the hybrid and the spraying treatments, the data of the same TABLE appear that the plants of the Barbarian F1 hybrid sprayed with calcium outperformed and recorded the highest plant height of 112.91 cm, while the minimum plant height was recorded in the plants of the Kizil F1 hybrid sprayed with calcium, which gave 100.04 cm. The binary interplay between the addition of humic acid and the spraying treatments was important, as the plants grown in the soil to which the humic acid was added at a proportion of 2 mg.l^{-1} and sprayed with calcium outperformed and gave the highest plant height which was 116.92 cm, while the minimum plant height was recorded in plants grown in untreated soil with humic acid (0 mg.l^{-1}) and sprayed with calcium, which gave 89.15 cm.

The triple interplay between the study factors had a important effect on plant height, as the plants of the Kizil F1 hybrid planted in the soil of added humic acid at a proportion of 2 mg.l^{-1} and treated with arginine acid were superior and recorded the highest plant height of 127.93 cm, while the minimum plant height was recorded in plants of the same hybrid untreated with humic acid and sprayed with calcium, which gave 78.00 cm.

TABLE 2. The impact of humic acid and sprahng treatments onplant heihgt (cm) of two hybrids of hot pepper.

Hybrids V	Humic acid H	Spraying T treatments					V * H
		S0	S1	S2	S3	S4	
V1	H0	97.33	103.67	107.14	112.69	113.22	106.81
	H1	107.50	105.11	115.78	113.66	113.58	111.13
	H2	113.89	111.77	113.00	112.39	105.22	111.25
V2	H0	100.00	93.67	71.17	78.00	81.33	84.83
	H1	111.44	103.78	115.11	108.22	99.67	107.64
	H2	115.11	114.78	120.83	113.89	127.39	118.40
			$L.S.D_{0.05 = 5.822}$				$L.S.D_{0.05 = 4.014}$
Means of spraying treatments		107.54	105.46	107.17	106.47	106.73	
			$L.S.D_{0.05}$ = NS				
							Means of hybrids
V×S	V_1	106.24	106.85	111.97	112.91	110.67	109.73
	V_2	108.85	104.07	102.37	100.04	102.80	103.62
$L.S.D_{0.05}$			3.531				4.250
							Means of humic acids
H×S	H_0	98.66	98.67	89.15	95.35	97.28	95.82
	H_1	109.47	104.44	115.44	110.94	106.62	109.38
	H_2	114.50	113.27	116.92	113.14	116.30	114.83
			$L.S.D_{0.05}$=4.166				$L.S.D_{0.05}$=2.968

Leaf Area ($m^2.plant^{-1}$)

The results of **TABLE (3)** appeared that the hybrids had excellence on the leaf area of hot pepper plants, as the Barbarian F1 hybrid plants outperformed those of Kizil F1 hybrid plants with an raise of t 31.94%.

The results also appear that the humic acid had no important effect on the leaf area of pepper plants.

The spraying treatments importantly affected the leaf area, as the plants sprayed with calcium and arginine appear a superiority for this feature contrast to the remnant of the spraying treatments and these two treatments did not differ importantly. In additions, there was no important difference between plants treated with jujube leaf extract and pomegranate peel extract in their effect on leaf area feature.

As for the binary interplays between the study factors, most of them appear important superiority in the leaf area, where the binary interplay between the hybrids and humic acid appear a important effect in this feature The plants of the Barbarian F1 hybrid treated with humic acid at a proportion of $2g.l^{-1}$ recorded the largest leaf area of 2.049 m^2, while the smallest leaf area was recorded in plants of of the Kizil F1 hybrid treated with the same proportion of humic acid, which quantitiesed to 1.33 m^2.

The interplay between the hybrid and the spraying treatments had a important effect, as the plants of the Barbarian F1 hybrid sprayed with calcium outperformed and gave the largest leaf area of 2.28 m^2 and the minimum leaf area recorded in the non-sprayed plants of the the Kizil F1 hybrid, which quantitiesed to 0.89 m^2. The interplay between humic acid and spraying treatments had a important superiority in the characteristic of leaf area, as plants to which humic acid was added at a proportion of 2 $g.l^{-1}$ and sprayed with calcium, the largest leaf area was 2.30 m^2 contrast to the minimum leaf area recorded in untreated plants with humic acid and non-sprayed with any of the spraying treatments, which recorded 0.89 m^2.

The triple interplay had a important effect on this feature, as the largest leaf area was recorded in plants of Barbarian F1 hybrid treated with humic acid at a proportion of 2 $g.l^{-1}$ and non-sprayed with any of the spraying treatments, as it reached 0.811 m^2.

TABLE 3. The impact of humic acid and sprahng treatments on leaf area of two hybrids of hot.

Hybrids V	Humic acid H	Spraying treatments					V * H
		S0	S1	S2	S3	S4	
V1	H0	0.97	2.95	1.87	2.22	1.48	1.90
	H1	1.68	1.66	1.30	2.07	1.80	1.70
	H2	2.24	1.59	2.13	2.55	1.95	2.09
V2	H0	0.81	0.88	1.89	1.20	2.28	1.41
	H1	1.00	1.41	1.59	1.61	2.26	1.58
	H2	0.87	1.19	0.91	2.05	1.62	1.33
			$L.S.D_{0.05}$ = 0.34				$L.S.D_{0.05}$ = 0.16
Means of spraying treatments		1.26	1.61	1.61	1.95	1.90	
			$L.S.D_{0.05}$ = 0.14				
							Means of hybrids
V×S	V_1	1.63	2.06	1.77	2.28	1.74	1.90
	V_2	0.89	1.16	1.46	1.62	2.05	1.44
$L.S.D_{0.05}$			0.20				0.18
							Means of humic acids
H×S	H_0	0.89	1.92	1.88	1.71	1.88	1.65
	H_1	1.34	1.53	1.44	1.84	2.03	1.64
	H_2	1.55	1.39	1.52	2.30	1.78	1.71
			$L.S.D_{0.05}$=0.24				$L.S.D_{0.05}$= NS

Chlorophyll Proportion of Leaves (mg.100gm^{-1})

It is clear from the results of **TABLE (4)** that the hybrids had a important effect on the total chlorophyll proportion in the leaves, where the plants of the Barbarian F1 hybrid excelled in this feature with an raise of about 36.16%.

Plants treated with humic acid at proportionf (1 and 2) g. l^{-1} were importantly superior to untreated plants, with an raise of (20.18 and 24.20)%, respectively and there was no important difference between the both proportions of humic acid.

The spraying treatments had appear impact on the total chlorophyll proportion in the leaves, where the plants sprayed with arginine were superior to the rest treatments with an raise of (10.20, 5.07, 11.75 and 6.82)%, there was also no important difference between the plants treated with jujube extract and calcium treatment .

The binary overlap between the hybrid and humic acid appear a important impact on this feature. The plants of the Barbarian F1 hybrid treated with humic acid at a proportion of 2 g. l^{-1} gave the highest proportion of 34.27 mg. 100gm^{-1}, while the minimum proportion of chlorophyll was in leaves of plants of Kizil F1 hybrid untreated with humic acid, which was 22.13 mg. 100gm^{-1} .

The interplay between the hybrids and the spraying treatments had a important effect, as the plants of the Barbarian F1 hybrid sprayed with arginine were the best in giving the highest proportion of 32.44 mg. 100 g^{-1} fresh weight, while the minimum proportion of chlorophyll was in the leaves of non-sprayed Kizil F1 hybrid plants which was 420.6 mg. 100 g^{-1}.

Plants add with humic acid at a proportion of 2 g. l^{-1} and sprayed with jujube exxtract excelled and recorded the highest proportion of 32.04 mg. 100 g^{-1} fresh weight, while the few proportion of chlorophyll was in the leaves of plants not treated with humic acid and sprayed with jujuba extract, which was 22.16 mg. 100 g^{-1}.

The triple interplay among the studied factors had a important effect on the total chlorophyll proportion in the leaves. The plants of the Barbarian F1 hybrid treated with humic acid at a proportion of 2 g. l^{-1} and sprayed with

jujuba leaf extract were superior, and recorded the highest proportion of 41.33 mg. 100 g^{-1} fresh weight, and the minimum proportion of chlorophyll was recorded in leaves of Kizil F1 hybrid treated with humic acid at a proportion of 1 gm.l^{-1} and non-sprayed with spraying treatments , which recorded 18.19 mg. 100 g^{-1}.

TABLE 4. The impact of humic acid and sprahng treatments on total chlorophyll (mg.100 pepper g^{-1}) of leaves of two hybridsofhot.

Hybrids V	Humic acid H	Spraying treatments					V * H
		S0	S1	S2	S3	S4	
V1	H0	26.33	22.33	19.33	22.67	28.33	23.80
	H1	32.00	33.00	34.57	30.00	37.00	33.31
	H2	34.33	41.33	31.67	32.00	32.00	34.27
V2	H0	19.38	21.99	21.80	23.24	24.25	22.13
	H1	18.19	19.30	21.98	25.61	25.92	22.20
	H2	24.36	22.74	21.76	23.73	21.36	22.79
			L.S.D$_{0.05}$ = 2.40				L.S.D$_{0.05}$ = 1.72
Means of spraying treatments		25.77	26.78	25.18	26.21	28.14	
			L.S.D$_{0.05}$ = 0.87				
							Means of hybrids
V×S	V_1	30.89	32.22	28.52	28.22	32.44	30.46
	V_2	20.64	21.34	21.85	24.20	23.84	22.37
L.S.D$_{0.05}$				1.69			2.18
							Means of humic acids
H×S	H_0	22.86	22.16	20.57	22.96	26.29	22.97
	H_1	25.09	26.15	28.27	27.81	31.46	27.76
	H_2	29.35	32.04	26.71	27.87	26.68	28.53
			L.S.D$_{0.05}$= 1.59				L.S.D$_{0.05}$= 0.98

Nitrogen (% Drymatter)

The results of **TABLE (5**) appeared that the plants of the Barbarian F1 hybrid were superior to the plants of the Kizil F1 hybrid, with an raise of 9.24%.

The plants treated with humic acid at a proportion of 1 g.l^{-1} appear a important superiority contrast to the control plants and plants treated with a proportion of 2 g.l^{-1} in the percentage of nitrogen in the leaves , with an raise of (8.57 and 12.81)%, respectively, while, the control plants outperformed contrast to those treated with humic acid at a proportion of 1 g.l^{-1}, with an raise of 3.59%.

The non-sprayed plants were superior in the percentage of nitrogen in the leaves contrast to all spraying treatments.

As for the binary interplays, they were all important. The interplay between the hybrid and humic acid had a important effect on this feature, as plants of the Barbarian F1 hybrid treated with humic acid at a proportion of 1 g.l^{-1} were importantly superior, as the highest percentage of nitrogen was recorded at 1.728% contrast to the minimum percentage recorded in leaves of the Kizil F1 hybrid treated with humic acid at a proportion of 2 g.l^{-1} quantitiesed to 1.262 %.

The interplay between the hybrid and the spraying treatments appear a important superiority in this feature. The leaves of non- spread plants of the Barbarian F1 hybrid recorded the highest percentage of nitrogen quantitiesed to

51.92 contrast to the minimum percentage recorded in the plants of the Kizil F1 hybrid sprayed with calcium quantitiesed to 1.083%, while the interplay between humic acid and spraying treatments appear that the plants treated with humic acid at a proportion of 1 $g.l^{-1}$ and non-sprayed were importantly superior and recorded the highest percentage of nitrogen which was 1.955% while, the plants treated with humic acid at a proportion of 2 $g.l^{-1}$ and sprayed with arginine acid recorded the minimum percentage of nitrogen ,which quantitiesed to 1.120%.

The triple interplay had a important effect on this feature, as the Barbarian F1 hybrid plants, treated with humic acid at a proportion of 1 $g.l^{-1}$ and sprayed with jujuba extract, outperformed and recorded the highest percentage of nitrogen quantitiesed to 2.020% contrast to the minimum percentage recorded in plants of the Kizil F1 hybrid treated with humic acid at a proportion of 2 $g.l^{-1}$ and sprayed with arginine acid, that reached 0.880%.

TABLE 5. The impact of humic acid and sprahng treatments on nitrogen (%) of leaves of two hybrids of hot pepper.

Hybrids V	Humic acid H	Spraying treatments					V * H
		S0	S1	S2	S3	S4	
V1	H0	1.866	1.022	1.560	1.670	0.940	1.411
	H1	1.990	2.020	1.830	1.780	1.020	1.728
	H2	1.920	0.910	1.980	1.880	1.360	1.610
V2	H0	1.660	1.908	1.920	1.030	1.350	1.573
	H1	1.920	1.340	1.250	1.220	1.830	1.512
	H2	1.280	1.920	1.230	1.000	0.880	1.262
			$L.S.D_{0.05}$ =0.008				$L.S.D_{0.05}$ = 0.003
Means of spraying treatments		1.772	1.520	1.628	1.430	1.230	
			$L.S.D_{0.05}$ = 0.003				
							Means of hybrids
V×S	V_1	1.925	1.317	1.790	1.776	1.106	1.583
	V_2	1.620	1.722	1.466	1.083	1.353	1.449
$L.S.D_{0.05}$				0.004			0.002
							Means of humic acids
H×S	H_0	1.763	1.465	1.740	1.350	1.145	1.492
	H_1	1.955	1.6800	1.5400	1.500	1.425	1.620
	H_2	1.600	1.415	1.605	1.440	1.120	1.436
			$L.S.D_{0.05}$=0.006				$L.S.D_{0.05}$ =0.002

Yield per Plant ($gm.plant^{-1}$)

The results **of TABLE (6**) showed that the hybrids had no important effect on plant yield.

The treatment with humic acid importantly affected the yield per plant ,as plants treated with humic acid at a proportion of 1 $g.l^{-1}$ appear a important superiority for this feature contrast to the control plants and plants treated with a proportion of 2 $g.l^{-1}$ with an raise of (22.11 and 8.70)%. Sequentially, whereas plants treated with a proportion of 2 $g.l^{-1}$ of humic acid outperformed plants untreated plants, with an raise of 12.33%.

The foliar spray had a important effect on the yield per plan, where the plants sprayed with pomegranate peel extract outperformed contrast to the control plants and plants sprayed with arginine acid with an raise of (11.06 and 18.28)%, respectively, and the plants treated with pomegranate extract did not differ importantly with plants treated

with jujuba leaves extract and calcium . Calcium-treated plants outperformed plants treated with arginine acid, with an raise of 15.61%, and the control treatment did not differ with plants treated with arginine acid.

Most of the binary interplays among the studied factors had important effects on the yield per plant, as the interplay between the hybrid and humic acid had no important effect on this feature, while the effect of the binary interplay between the hybrid and spraying treatments had a important effect on this feature, as plants of Barbarian F1 hybrid sprayed with pomegranate peel extract outperformed and recorded the highest yield per plant of 628.7 g, while the minimum yield per plant recorded in plants of the same hybrid sprayed with jujuba leaves extract, which quantitiesed to 409.4 g.

The plants treated with humic acid at a proportion of 1 $g.l^{-1}$ and sprayed with calcium outperformed and recorded the highest yield per plant which was 606.9 g, while the minimum yield per plant was recorded in untreated plants with humic acid and sprayed with jujuba leaves extract, which quantitiesed to 373.8 g.

TABLE 6. The impact of humic acid and sprahng treatments onyield per plant ($gm.plant^{-1}$) of two hybrids of hot pepper.

Hybrids V	**Humic acid H**	**Spraying treatments**					**V * H**
		S0	**S1**	**S2**	**S3**	**S4**	
V1	H0	485.1	345.4	602.2	405.6	422.9	452.2
	H1	650.3	392.5	591.1	629.2	541.0	560.8
	H2	408.6	490.3	692.9	449.3	487.2	505.7
V2	H0	352.7	402.2	472.2	502.4	477.8	441.5
	H1	426.9	808.1	478.8	584.5	353.0	530.3
	H2	573.0	523.1	380.1	573.6	438.0	497.5
			$L.S.D_{0.05}$ = 109.9				$L.S.D_{0.05}$ = N.S
Means of spraying treatments		482.8	493.6	536.2	524.1	453.3	
			$L.S.D_{0.05}$ =				
							Means of hybrids
V×S	V_1	514.7	409.4	628.7	494.7	483.7	506.3
	V_2	450.9	577.8	443.7	553.5	422.9	489.8
$L.S.D_{0.05}$				65.3			N.S
							Means of humic acids
H×S	H_0	418.9	373.8	537.2	454.0	450.3	446.8
	H_1	538.6	600.3	535.0	606.9	447.0	545.6
	H_2	490.8	506.7	536.5	511.5	462.6	501.6
			$L.S.D_{0.05}$=77.7				$L.S.D_{0.05}$=42.9

It is clear from the previous TABLEs that most of the studied factors and most of their interplays had a important effect on vegetative parameters and chemical composition of leaves of the pepper plant, as the Barbarian F hybrid outperformed on plant height , leaf area, chlorophyll and nitrogen ,whereas Kizil F1 hybrid outperformed in the percentage of potassium. The differences between the two hybrids in the above-mentioned indicators may be consequent to the genetic differences between them which occurs consequent to the variation in the genetic factors controlling the specific characteristics of the fruits (Mahdi, 2016).

The treatment with humic acid importantly affected most of those studied chracteristics, this superiority is consequent to the function of humic acid in increasing the absorption of nutrients by the plant, leading to an improvement in the nutritional status of the plant, which was positively reflected in the growth stage, causing an raise in the total proportion of nitrogen in the leaves that considers an essential element in biological processes, metabolism, growth and the manufacture of amino acids and protein in plant cells (Nardi *et al.*, 2004 ;Taain *et al.*,2021). The positive effect of treatment with humic acid In those components, the nitrogen released into the soil raises, which raises its accumulation inside the plant and thus raises the content of chlorophyll in the leaves (Peter

and Rosen, 2005) , in addition to the function of humic acid, which stimulates the metabolic processes of the plant and thus raises plant growth, especially the roots, which leads to an raise in the efficiency of absorption of nutrients by the roots, and that These results agree with the researchers (Abdel-Mawgoud et al., 2007 and Ozer *et al*.,(2017) on tomato plants.

The foliar spray had a important effect on leaf area and the proportion of chlorophyll in the leaves, as the spraying with arginine acid caused a important raise in these features, while the control treatment was superior in the percentage of nitrogen, phosphorous and potassium. The effect of arginine my be consequent to facilitate the absorption and transport of microelements and it's impact on the permeability of cell membranes, causing the efficiency of the photosynthesis process, thus increasing the proportion of chlorophyll and increasing the manufacture of carbohydrates in the leaves (Hassan *et al*., 2010).

CONCLUSION

It is concluded from the current study that adding humic acid at a proportion of spraying nanoparticles of seaweed at a proportion of (2 and 1) g. l^{-1}, spraying foliar treatments (jujuba leaves extract ,arginine acid and calcium) had a important effect on increasing the most of studied indicators of hot pepper planted in unheated plastic houses conditions.

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