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EFFECT OF SPRAYING WITH HUMIC AND ASCORBIC ACIDS ON THE GROWTH AND YIELD OF RICE

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Abstract

An experiment was conducted in private field in season of 2019 Al-Tajia village , Kufa district, Najaf governorate to determine the effect of humic acid spraying (0, 2, 4.0 $g.L^{-1}$) and ascorbic acid (0, 50, 100 ,150 $mg.L^{-1}$) in following stages, tillering, heading and ripening to study of growth and yield of rice c.v. Yasmin.

Factorial experiment with arrangement of Randomized Complete Block Design (RCBD) was used with 2 factors, results showed a significant differences for humic and ascorbic acid application on growth and yield. The highest results were obtained with humic acid of 4.0 $g.L^{-1}$ and 100 $mg.L^{-1}$ ascorbic acid in all study parameters.

Keywords **:** Humic acid, ascorbic acid, rice.

Introduction

Rice' *Oryza sativa* L.' is one of the most important cereal crops with is used as a source of nutrition for more than half of the world's population (Iizumi and Ramankutty, 2016), which increases the interest of researchers in increasing the quantity and quality of its production and maintaining the environmental safety of the product and the field.

Organic fertilizer plays an important role in increasing soil fertility, improving its physical and chemical properties, and increasing nutrient elements availability, especially micronutrient elements, where it works to provide the elements directly and indirectly by release non-availability elements in soil by adjusting soil pH. (Al-Taey *et al*., 2019; Al-Taey and Al-Musawi, 2019), Humic acid is one of the agricultural techniques friendly to the environment and general health (Burhan and AL-Taey, 2018) ,which is as an organic matter resulting from the decomposition of plant and animal substances that improve soil physical and chemical properties and enhancing metabolic activity and plants physiological functions (Antoun *et al*., 2010), Aziz *et al*. (2014) found that spraying rice plants with humic acid at a level of 2 liters per acre led to an increase in plant height; plant spike number ;spike length and grain yield for 2012 and 2013 growing seasons, Kandil *et al*. (2016) found that spraying wheat plants with Humic acid at a concentration of 5 $ml.L^{-1}$ resulted in a significant increase in spike number , spike length, grain number in spike, 1,000 grain weight and grain yield.

The accumulation or collection of free radical ions such as Hydrogen peroxide, Superoxide, and hydroxyl radical in leaves as a result of plant aging which works to reduce or decrease rice yield (Zeng *et al*., 2018). Ascorbic acid with its non-enzymatic mechanism helps plants to get rid of the harmful effect of free radicals (Gest *et al*., 2013). Moreover, this acid also participates as a Co-factor of many enzymes such as α-Ketoglutarate (Arrigoni and De- Tullio, 2000) and also participates in the secondary chain of electron transport in the Glutathione-Ascorbic acid Cycle (Traber and Stevens, 2011) and has an important role in plant growth (Ozdener and Kutbay, 2008), Flowering (Barth *et al*., 2006) and aging delay (Kime *et al*., 2008). This experiment aim was to determine the singular effect of humic and ascorbic acids and it interactions on the growth and yield of rice.

Materials and Methods

An experiment was conducted in specialist field for rice cultivation at Al-Tajyia village, Kufa district, Najaf governorate .samples were taken from field soil at 30 cm. depth for different places, put together to make composite sample to measure some physical and chemical criteria (Table 1). Field soil was prepared by leveling, ploughing and fertilizing with NPK , 10: 10:20 at a level of 200 kg. h^{-1} (Herve *et al*., 2017), then, field was divided into three blocks, each block divided into 12 experimental units (2 x 2 m) by leaving 0.5 m as safe distance between each experimental unit to ensure that there is no spray from other acids treatment used.

Table 1: Some physical and chemical characteristics of field soil

Character		Value	Unit	
Texture	sand	170	$g.k^{-1}$	Sandy clay loam
	loam	480	$g.k^{-1}$	
	clay	350	$g.k^{-1}$	
O.M		1.5	$g.k^{-1}$	
Available N		70.3	$mg.k^{-1}$	
Available P		15.0	$mg.k^{-1}$	
Available K		260	$mg.k^{-1}$	
EC		3.6	$ds\ .m^{-1}$	
pH		7.8	---	

Seeds sown on June 14th with plastic trays of dimensions (100 x 50 x 15 cm) containing a mixture of river sand and peat with a ratio of 1: 2 to produce seedlings. On14th July 15th. Seedlings were transferred into the experimental units in the field as wet transplanting by making lines inside the experimental area . The distance between one line and another was 30 cm, and the distance between the seedlings was 15 cm. Nitrogen fertilization of all experimental units was done using urea fertilizer at a level of 200 kg $N.h^{-1}$ twice after transplanting, i.e. 30 and 60 days.

Humic and Ascorbic Acids spraying was done at the stages of Tillering, Heading and Ripening of each of the experimental unit.

Humic acid spraying was done at a concentration of 2.0 $g.L^{-1}$ 'manufacturers recommendation' and 4.0 $g.L^{-1}$ as double of the recommendation that contains 61% humic acid and 16.3% fulvic acid, 10.2% potassium, and 12.5% amino acid group (Tryptophan, Phenylalanine, Lysine, Methionine, and Glutamine), besides, control treatment (water spraying).

Ascorbic acid was sprayed at a concentration of 50, 100, and 150 $mg.L^{-1}$,and control treatment (water spraying).

Growth indicators were included Crop Growth Rate (CGR), and Relative Growth Rate (RGR) ,Absolute Growth Rate (AGR), by taking a $0.25m^2$ randomly throwing a wooden square in each experimental unit and then air drying. Area of flag leaf and plant height were also measured. While indicators of yield and its components included measuring : the length of spike, its number of branches, grains number, days to maturity, 1000 grains weight and grain yield per unit area.

Treatments were distributed as factorial experiment with Randomized Completely Block Design(RCBD). Means were compared using the least significant difference test (LSD) at probability of 0.05.

Results and Discussion

First: vegetative growth parameters

Table (2) showed that there were a significant effects of spraying humic acid on growth parameters with a conc. of 4.0 g. L^{-1} in :14.09 $g.m^2$. day crop growth rate ; 0.0485 $g.day^{-1}$, absolute growth rate; 0.028 $g.g^{-1}.day^{-1}$ relative growth rate ; 15.2 cm^2 .flage leaf area and 83.5 cm . plant height at harvest , respectively, compared to the control treatment (water spraying) which gave 12.66 $g.m^2.\ day^{-1}$ crop growth rate;0.0425 $g.day^{-1}$ absolute growth rate ; 0.026 $g.g^{-1}.day^{-1}$ relative growth rate ; 13.5 cm .flag leaf area and 75.7 cm. plant length respectively. These results may be due to the role of humic acid and fulvic acid in promoting plant growth as well as the role of companying amino acids such as Tryptophan and Methionine, which increase the concentrations of some growth hormones, such as oxins and cytokinins, which help in increase plant growth parameters.

Table 2: Effect of humic and ascorbic acid sprayings and its interactions on vegetative growth parameters

Treatments			C.G.R $g.m^2.day^{-1}$	R.G.R $g.m^2.day^{-1}$	A.G.R $g.day^{-1}$	Flag leaf area cm^2	Plant height cm
Humic Acid ($g.L^{-1}$)		0	12.66	0.026	0.0425	13.5	75.7
		2	13.45	0.027	0.0435	14.2	78.3
		4	14.09	0.028	0.0458	15.2	83.5
L.S.D (0.05)			1.15	0.001	0.0014	0.46	2.2
Ascorbic Acid ($mg.L^{-1}$)		0	12.64	0.025	0.0432	13.3	74.6
		50	13.18	0.026	0.0437	13.9	78.3
		100	14.04	0.028	0.0446	15.3	80.5
		150	13.74	0.027	0.0441	14.6	83.1
L.S.D (0.05)			1.54	0.0012	0.0017	0.52	2.8
Humic Acid ($g.L^{-1}$) * Ascorbic Acid ($mg.L^{-1}$)	0	0	12.21	0.024	0.0421	12.8	72.1
		50	12.50	0.025	0.0424	13.2	75.9
		100	13.11	0.027	0.0428	14.3	76.5
		150	12.83	0.026	0.0426	13.7	78.1
	2	0	12.62	0.025	0.0427	13.3	74.3
		50	13.23	0.026	0.0433	13.9	77.4
		100	14.20	0.028	0.0442	15.1	79.8
		150	13.76	0.027	0.0437	14.5	81.5
	4	0	13.10	0.026	0.0448	13.8	77.5
		50	13.82	0.027	0.0453	14.6	81.6
		100	14.80	0.029	0.0477	16.6	85.3
		150	14.63	0.028	0.0462	15.7	89.7
L.S.D (0.05)			1.55	0.0018	0.0037	0.98	5.5

The table above shows that there were significant effects of ascorbic acid sprayings on studied growth parameters, it was significantly superior to acid spraying with a concentration of 100 mg. L^{-1} in giving 14.04 $g.m^2.day^{-1}$ CGR; 0.0446 g $.day^{-1}$ AGR; 0.028 $g.g^{-1}.\ day^{-1}$ RGR; 15.3 cm^2.flag leaf area and 80.5 cm .plant height, respectively ,as, compared to 12.44 $g.m^2.day^{-1}$ CGR; 0.0432 g. day^{-1}AGR; 0.025 $g.g^{-1}.day^{-1}$ RGR; 13.3 cm^2.flag leaf area and 74.6 cm .plant height for control treatment, respectively.

These results can be attributed to the role of ascorbic acid in increasing the reactions of cellular biology by increasing the efficacy of antioxidants in the respiratory cycle and the electron transport chain which increased growth parameters (Toth *et al*., 2009), Pignocchi *et al*., (2003) indicated that the cells expansion and elongation are associated with the activity increase with ascorbate oxidase enzyme that is affected by the concentration of ascorbic acid.

Interaction between spraying humic acid with 4 $g.L^{-1}$ x 100 mg. L^{-1} ascorbic acid produced the highest means for the above parameters, which reached to :14.80 $g.m^2.2.day^{-1}$CGR; 0.0477 g $.day^{-1}$ A.G.R ; 0.029 g. g^{-1} day^{-1} RGR; 16.6 cm^2.flag leaf area; 85.3 cm. plant height, respectively. While, no spraying for both acids produce these values: 12.21 $g.m^2.day^{-1}$ CGR ;0.0421 $g.day^{-1}$AGR; 0.024 g. $g^{-1}.\ day^{-1}$ RGR; 12.8 cm^2.flag leaf area; 72.1 cm.plant height, respectively for control treatment.

Table (3) clear a significant effects of humic acid spraying on yield and its parameters, they were significantly exceeded due to the humic acid spraying particularly with 4.0 g. L^{-1} that gave 19.30 cm. spike length; 10.21 spike branch no., 113.0 spike grain no.; 150 day to maturity; 18.97 g.1000 grains weight ; 3.51 ton.h^{-1}. grain yield , respectively, compared to control treatment that gave 19.0 cm. spike length ; 10.0 spike branch no.; 106.6 spike grain no.; 148.5 days to maturity; 17.5 g.1000 grains weight; 3,36 ton. h^{1} .grain yield. The reason for these results could be attributed to the influence of humic acid outcome on growth accumulates which appears and influence the parameters of yield and its components.

Table 3: Effect of humic and ascorbic acids spraying and its interactions on yield component parameters

Treatments			Spike length (cm)	Spike branch	Grain. spike^{-1}	Days number hamlet	wt.of grain 1000 (g)	Grain yield (t.h^{-1})
Humic acid(g.L^{-1})		0	19.01	10.01	106.6	148.5	17.53	3.357
		2	19.13	10.12	109.4	149.2	17.87	3.403
		4	19.30	10.21	113.0	150.0	18.97	3.512
L.S.D (0.05)			0.6	0.35	7.5	2.43	0.33	0.197
Ascorbic acid (mg.L^{-1})		0	19.05	10.05	105.9	148.3	18.02	3.386
		50	19.13	10.09	108.1	149.0	18.09	3.413
		100	19.23	10.18	113.4	150.3	18.21	3.461
		150	19.17	10.12	111.3	149.4	18.15	3.434
L.S.D (0.05)			0.8	0.47	9.9	3.22	0.38	0.528
Humic acid (g.L^{-1}) * Ascorbic acid (mg.L^{-1})	0	0	18.89	9.95	103.7	147.4	17.48	3.348
		50	18.99	9.98	105.8	148.1	17.51	3.351
		100	19.11	10.07	109.2	149.6	17.58	3.369
		150	19.04	10.02	107.6	148.8	17.55	3.358
	2	0	19.06	10.06	106.1	148.2	17.78	3.359
		50	19.11	10.09	108.2	149.1	17.84	3.391
		100	19.18	10.18	112.8	149.9	17.95	3.449
		150	19.15	10.14	110.5	149.5	17.89	3.411
	4	0	19.21	10.14	107.8	149.3	18.81	3.451
		50	19.28	10.19	110.2	149.7	18.93	3.498
		100	19.39	10.28	118.3	151.3	19.11	3.564
		150	19.33	10.21	115.7	149.8	19.02	3.533
L.S.D (0.05)			1.5	0.96	19.7	6.48	0.63	0.529

Table (3) also shows the presence of significant effect for ascorbic acid sprayings on yield and its components. These were statistically superior to spraying with concentration of 100 mg. L^{-1} which gave:

19.2 cm.spike length; 10.2 spike branch no.; 113.4 spike grain no.; 150.3 days to maturity; 18.2 g.1000 grain weight and 3.461 ton.h^{-1}. grain yield ,compared to 19.1 spike length; 10.1 spike branch no.; 105.9 spike grain no.; 148.3 days to maturity; 18.0 g. 1000 grain weight and 3.39 ton. h^{-1}. grain yield, respectively, for control treatment.

These differences between the above results could be due to the fact the highest concentrations of ascorbic acid are distributed between Chloroplasts ;Mitochondria and Peroxisomes activities (Zechmann *et al*., 2011) where these organelles specializes in energy and dry material production in plant cells which confirms the participation of ascorbic acid to increase the frequency of biochemical reactions which increase the effectiveness of enzymes to protect them from oxidation caused by plant exposure to abiotic stresses.

The overlap between humic acid of 4.0 g . L^{-1} and 100 mg. L^{-1} ascorbic acid resulted in the highest values of yield and yield components as follows : 19.4 cm. spike length ; 10.3 spike branch no.; 118.3 spike grain no; 151. 3 day to maturity; 19.11 g.1000 grain weight and 3.564 ton.h^{-1}, compared to 18.89 cm spike length; 9.95 spike branch no.; 103.7 spike grain no.; 147.4 day to maturity; 17.5 g.1000grain weight and 3.348 ton.h^{-1}. grain yield, that obtained from control treatment .

It could be concluded that humic acid spraying accompanied with ascorbic acid spraying would produce the highest values of vegetative growth , yield and its components.

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