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Response of Growth, Yield and Nutritional Status of Cucumber Plants (*Cucumis sativus* L.) to Different Foliar Application of Humic Acid and Naphthalene Acetic Acid

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ABSTRACT

Field experiment was conducted during the successive season of 2016 in the Experimental Station of the National Research Centre in El-Nubaria region, Behira Governorate, North Egypt, to study the effect of humic acid (0, 1, 2 and 3 g/L) and Naphthalene Acetic Acid (NAA) (0, 50 and 100 ppm) as foliar spray on growth, yield and nutritional status of cucumber plants (*Cucumis sativus* L. cv. Beta-Alpha). Cucumber plants were splashed three times at 15 day intervals with various concentrations of humic acid and NAA three weeks after planting.

The results indicated that the values of plant height, number and dry weight of leaves were raised up significantly under high levels of humic acid and naphthalene acetic acid ($3gl^{-1}$ and 100 ppm, respectively). As well as high level of humic acid ($3gl^{-1}$) under high level of naphthalene acetic acid (100 ppm)gave highest values of cucumber yield and yield components like number of fruits, fruit length, fruit diameter and yield per plant (27.94, 23.84 cm, 5.620 cm and 2.910 kg fed^{-1}, respectively). Naphthalene acetic acid (100 ppm) gave high values of N, P, K, Ca and Mg uptake especially under high rate of humic acid ($3\ gl^{-1}$) (616.4, 147.3, 713.8, 502.2 and 113.7mg kg^{-1}, respectively).

Key words: Humic acid, naphthalene acetic acid, cucumber plants, Growth, Yield, Nutrients uptake

Introduction

Cucumber (*Cucumis sativus* L.) is one a major vegetable crop in worldwide. Though it's calorie and nutritional value is very faint, it was a essential provenance of minerals and vitamins in the human regimen (Mah, 1989).

Humic acid was one a largest components of humic substances. Humic acids were formative out of the chemical and biological humification of plant and animal matter and through the biological vigor of microorganisms(Saruhan *et al*., 2011).The effects of humic acids on plant growth hinge on the origin and condensation. Lower molecular size fraction easily reaches the plasma lemma of plant cells, limiting anaffirmative effect on plant growth, as well as ultimate effect at the level of plasma membrane and nutrient uptake. Upshots seen on the middle metabolism were low comprehends; however it imitate that humic acids may leverage both respiration and photosynthesis (Nardi *et al*., 2002).

Plant growth regulators were synthesized indigenously by plants, but sundry studies confirmed that plants can react to exogenous enforcement of these chemicals. An exogenous implementation of plant growth regulators affects the endogenous hormonal pattern of the plant, either by subjection of sub-optimal levels or by interaction with their synthesis (Arshad and Frankenberger, 1993).Naphthalene acetic acid (NAA) was synthetic plant hormone in the auxin family. Naphthalene acetic acid (NAA) was famed to catalyze cell division, cell elongation, elongation of shoot, photosynthesis, RNA synthesis membrane permeability and water uptake also involved in many physiological processes such banning of pre harvest fruit drop, flower inducement, fruit set, delayed senescence and forbidding of bud sprouting and increased the yield of fruit crops (Islam, 2007 and Cho *et al*., 2008).

The study aimed to effects of different levels of humic acid and Naphthalene acetic acid on growth, yield and nutritional status of cucumber plants (*Cucumis sativus* L. cv. Beta-Alpha).

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Material and Methods:

This study was conducted in the Experimental Station of the National Research Centre in El-Nubaria region, Behira Governorate, North Egypt, during the successive season of 2016. Cucumber plants (*Cucumis sativus* L. cv. Beta-Alpha).This work aimed to study the effect of humic acid (HA) and Naphthalene acetic acid (NAA) as foliar spraying on growth, yield and nutritional status of cucumber plants. Seeds were sown on 8 April 2016 in rows 80 cm apart with an intra-row spacing of 50 cm. Cucumber plants were grown in a sandy soil with trickle irrigation system.

Table 1: Some physical and chemical properties of the soil used.

Soil property	Value	Soil property	Value
Particle size distribution %		pH (1:2.5 soil suspension)	7.80
Sand	90.08	EC (dS m^{-1}), soil paste extract	1.34
Silt	0.66	Soluble ions (mmol L^{-1})	
Clay	9.26	Ca^{++}	7.02
Texture	Sandy	Mg^{++}	2.53
$CaCO_3$ %	2.90	Na^{+}	2.98
Saturation percent %	23.30	K^{+}	0.91
Organic matter%	0.10	CO_3^{--}	nd
Available N (mg kg^{-1})	12.3	HCO_3^{-}	2.20
Available P (mg kg^{-1})	1.8	Cl^{-}	3.98
		SO_4^{--}	7.22
Available K (mg kg^{-1})	47.5	CEC (cmol kg^{-1})	6.50

Humic acid (HA) solutions were sprayed in rates of (0, 1, 2 and 3 g/L). The bottom leaf surfaces of plants were totally wetted with HA solutions in order to accomplish faster and more effective absorption of HA during late afternoon or evening hours (Hull *et al.,* 1975). Naphthalene acetic acid (NAA) solution was sprayed in rates of (0, 50 and 100 ppm). Cucumber plants were foliar-sprayed three times at 15 day intervals with different concentrations of HA and NAA three weeks after planting utilizing a hand-held sprayer.

Random samples of three plants were taken at 75 days after sowing from each treatment to measure plant growth parameters i.e. plant height (cm), number of leaves/plant, and weight of leaves/ plant (g). Cucumber fruits at marketable stage were harvested twice weekly. At harvest time the number of fruits/plant, mean weight of fruit, fruit length, fruit diameter and yield (kg/plant) in each treatment were recorded. Chemical analysis of cucumber leaves was carried out after harvest to determine mineral contents (N, P and K). The plant materials were dried in an oven at 70 °C until a constant mass was reached and then they were grounded for chemical analysis and wet digested using H_2SO_4:H_2O_2 method (Cotteine, 1980). Total nitrogen was determined using the micro-Kjeldahl method; P was assayed using molybdenum blue method and determined by spectrophotometer, as well as K was determined by Flame Photometer(Chapman and Pratt, 1961), while Ca and Mg were determined using atomic absorption spectrophotometer using the method of (A.O.A.C., 1990).

Split plot design with three replicates was followed; humic acid rates were arranged in main plots, while NAA solution rates were distributed in the sub plots. Data were subjected to the analysis of variance (ANOVA) to compare the effects of foliar application treatments (Snedicor and Cochran, 1980). When significant differences occurred, the means were separated using least significant difference test (LSD, $P < 0.05$).

Results and Discussion:

The results in Table (2) showed to effect of different levels of naphthalene acetic acid under different rates of humic acid on some growth parameters of Cucumber (*Cucumis sativus* L.) plant such as plant height, number and dry weight of leaves. When humic acid and NAA rates increased from 0 to 3 gl^{-1} and 0 to 100 ppm respectively, the values of plant height, number and dry weight of leaves were increased significantly. The high values of previous parameters were achieved under high rate of humic acid and NAA (3gl^{-1} and 100 ppm, respectively).

Table 2: Effect naphthalene acetic acid and humic acid levels on some growth parameters of Cucumber (*Cucumis sativus* L.) plant.

Humic acid gl^{-1}	Naphthyl acetic acid (ppm)	Plant height (cm)	No. of leaves	Dry weight of leaves g $plant^{-1}$
0	0	76.75	34.75	61.94
	50	88.00	63.59	105.6
	100	94.25	72.5	123.1
1	0	79.92	44.83	69.27
	50	90.33	70.50	106.8
	100	96.67	76.75	132.4
2	0	82.09	43.00	80.27
	50	99.34	76.00	133.3
	100	102.3	80.00	139.5
3	0	89.92	57.34	101.4
	50	101.3	77.25	142.6
	100	103.9	83.42	147.7
$L.S.D._{0.05}$		3.280	8.385	48.28

Foliar spray or soil addition of humic acid promoting growth of several vegetable crops by increasing root forests and surface area of leaves, which lead to improved plant growth (Akinremi *et al.,* 2000 and Cimrin and Yilmaz, 2005).

Naphthalene Acetic Acid (NAA) belonged to synthetic forms of auxins, which played clef role in cell protraction, cell split, vascular tissue, root initiation, leaf senescence, leaf and fruit abscission, fruit setting and flowering (Davies, 1987). Growth and yield parameters of rice were significantly promoted in response to different auxin levels (Zahir *et al*., 1998).

Data in Table (3) indicated to response of cucumber yield and yield components like number of fruits, fruit length, fruit diameter and yield per plant to various combination levels between HA and NAA. The results showed that increasing the levels of humic acid from 0 to 3 gl^{-1} and naphthalene acetic acid from 0 to 100 ppm increased significantly number of fruits, fruit length, fruit diameter and yield per plant. It was noticed that cucumber plants fertilized with fourth level of humic acid (3g/L) under high level of NAA (100 ppm) achieved the highest significant values of the aforementioned parameters.

Table 3: Effect naphthalene acetic acid and humic acid levels on yield and yield components of Cucumber (*Cucumis sativus* L.) plant.

Humic acid gl^{-1}	Naphthyl acetic acid (ppm)	No. of fruits/plant	Fruit length (cm)	Fruit diameter (cm)	yield Kg/plant
0	0	6.535	8.965	2.600	0.505
	50	14.25	10.18	3.435	1.170
	100	17.87	11.57	3.700	1.525
1	0	6.900	12.09	2.940	0.540
	50	11.39	13.59	3.465	1.010
	100	15.62	14.47	3.785	1.410
2	0	8.670	17.27	3.235	0.780
	50	16.49	20.82	3.975	1.595
	100	19.17	21.67	4.755	1.920
3	0	7.515	18.53	3.720	0.690
	50	20.19	22.17	4.715	2.150
	100	27.94	23.84	5.620	2.910
$L.S.D._{0.05}$		1.98	0.945	0.28	0.130

Humic acid was considered as an important source of organic matter and their effects on yield and its components could be through their enhancing effect on increase soil moisture holding capacity, improve soil texture as well as promote the uptake of nutrients leading to stimulation of plant growth (higher biomass production) and consequently on total yield (Zhang *et al*.,2003).

Naphthalene Acetic Acid (NAA), a wide broad, somatotropin -like growth regulator in plants. It was created important effects in raising growth of acute ends for the root system, fulfill in extra, straighter and thicker roots. NAA can increase fruit setting ratio and prohibit fruit dropping (Raoofi *et al*., 2014).

The obtained result in Table (4) showed that adding of humic acid significantly increased nutrients (N, P, K, Ca and Mg) uptake of leaves cucumber than those obtained from the untreated plants. The application of3 gl^{-1} from humic acid gave the highest values of N, P, K, Ca and Mg uptake. Incorporation of humic acid into soils encouraged root growth, as well as increased the proliferation, branching and initiation of root hairs and could partly be referred to boost elementals uptake (Atiyeh *et al*., 2002). Increasing NAA levels from 0 to 100 ppm significantly increased N, P, K, Ca and Mg uptake of leaves cucumber, as well as the high level of NAA (100 ppm)gave high values of N, P, K, Ca and Mg uptake especially under high rate of humic acid (3 gl^{-1}) (616.4, 147.3, 713.8, 502.2 and 113.7 mg kg^{-1}, respectively).

Naphthalene Acetic Acid (NAA) promoted vegetate growth by active cell division, cell enlargement and cell elongation. As well as NAA could increase the osmotic uptake of water and nutrients (Bairwa and Mishra, 2017).

Table 4: Effect naphthalene acetic acid and humic acid levels on nutrients uptake of leaves Cucumber (*Cucumis sativus* L.) plant.

Humic acid gl^{-1}	Naphthyl acetic acid (ppm)	N	P	K	Ca	Mg
		mg kg^{-1}				
0	0	72.28	21.06	138.3	111.5	20.63
	50	158.7	43.61	366.1	246.4	43.30
	100	209.3	58.72	500.6	336.4	55.76
1	0	133.9	27.22	195.1	143.2	25.84
	50	279.8	51.26	402.3	281.2	50.94
	100	414.8	82.09	569.3	381.7	71.50
2	0	190.8	40.70	259.5	187.3	33.47
	50	476.3	85.31	568.8	375.9	84.91
	100	473.9	106.4	660.3	422.7	103.2
3	0	261.9	59.83	398.8	250.2	50.00
	50	559.4	107.4	646.4	442.1	94.54
	100	616.4	147.3	713.8	502.2	113.7
L.S.D. 0.05		44.10	15.70	56.20	28.10	14.01

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