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Influence of Potassium Humate on Growth and Chemical Constituents of *Jatropha curcus L.*

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Abstract: A pot experiments were conducted during in the two seasons of 2013-2014 at Research and Production Station of National Research Center,Nubaria , Behaira Governrate, Egypt to evaluate the effect of foliar spray with potassium humate (0.0, 0.5, 1.0, 1.5 , 2.0 , 2.5 and 3.0% K-humate) on growth and some chemical constituents of *Jatropha curcus L.* plants. Most criteria of vegetative growth expressed plant height, stem diameter, leaves number/plant, leaf area, root length, fresh and dry weight of leaves, stems and roots as will as chemical composition which affected by application of concentration of K-humate under study, as well as, chlorophyll a, b and carotenoids and total carbohydrates %, the highest values were obtained from 2.0, 2.5 and 3.0 % k-humate. All growth parameters and chemical constitutes were increased by increasing humic acid concentrations compared with control plants. Therefore, humic acid may recommended for promoted growth parameters and chemical constitutes of *Jatropha curcus L.* plants.
Keywords: *Jatropha curcus L*, potassium humate, vegetative growth, chemical constitutes.

Introduction

Among the oil-bearing tree species, *Jatropha curcas* is currently becoming an interesting crop for the production of biodiesel due to some of its interesting properties including resistance to drought, possibility to grow well and quickly on marginal lands without much fertilizer inputs and the need for only moderate rainfall[1]. *Jatropha curcas* is to native to the American tropics Mexico and Central America, is cultivated in tropical and subtropical regions around the world. It belongs to Family Euphorbiaceae.

Humic substances are organic compounds that result from the decomposition of plant and animal materials.(HS) and their salts which derived from coal and other sources may provide a viable alternative ameliorate, liming soil acidity and improve soil structural stability and fertility and by influencing nutrient uptake and root architecture[2,3]. HS have been shown to contain auxin and an auxin like, which promote the chelation of many elements and make these available to plants, aid in correcting plant chlorisis, enhancement of photosynthesis density, and plant root respiration has resulted in greater plant growth with humate application[4].Increase the permeability of plant membranes due to humate application resulted in improve growth of various groups of beneficial microorganisms, accelerate cell division, increased root growth and all plant organs for a number of horticultural crops and turf grasses, as well as the growth of some trees[5] . The aim of this work is enhancing the vegetative growth of Jatropha plants by application of humic acid, as well as its chemical composition at Nubaria region, Egypt.

Material and Methods

The study was carried out at Research and Production Station of National Research Centre,Nubaria of National Research Center during two successive seasons of 2013 and 2014. The main objective of this study was to investigate the effect of Potassium humate on growth, chemical constituents of Jatropha plants. The soil of the experimental side was sandy loam. The physical and chemical properties of the soil are shown in Table (1).

One year old seedlings of *Jatropha curcus* L. were obtained from nursery of forestry Department Horticulture Research Institute, Agriculture Research Centre. The seedlings were planted on 18th March, plastic pots 30 cm in diameter, one plant/pot .The average height of seedlings were (15-20 cm) the available commercially fertilizer used through this experimental work was kristalon (NPK 19-19-19) produced by Phayzon company, Holland. The fertilizer rates was (5.0 gm/pot) used in four equal doses after 4, 8, 16, 20 weeks from transplanting. The Potassium humate of this study is produced by alkaline treatment of Victoria brown cool and is commercially viable in Australia (18 % humate).

Plants were sprayed with twice freshly prepared solution of potassium humate at (0.5, 1, 1.5, 2.0, 2.5 and 3.0%) in addition to the untreated plants (control) which were sprayed with tap water. The plants were treated with K-humate two times of 30 days intervals starting on 20th May in both seasons. At last week of November of 2013 and 2014, the following data were recorded : plant height(cm^2), stem diameter(mm),root length(cm), number of branches/plant, number of leaves, fresh and dry weight of shoot and root (gm), leaf area (cm).the experiment was sit a completely randomized design with seven treatments and six replicates of each treatment. The data were statistically analyzed using the least significant difference (L.S.D) at 5% level[6]. The following chemical analysis were determined: Chlorophyll (a,b) and carotenoids were determined[7]. total carbohydrates percentages were determined[8]. Nitrogen, Phosphorus, Potassium and Sodium were determined in leaves and roots according to the described method [9]. The physical and chemical properties of the soil were determined[10].

Result and Discussion

Vegetative growth:

The results in Tables (2,3) show that plant growth is a function of nutrient supply providing, from Tables(2,3) showed that plant height , stem diameter, leaves number /plant, leaf area, root length, fresh and dry weight of shoots and dry were gradually significantly increased by increasing the concentration of Potassium humat to 3.0% than the control plants. The highest significant increases were recorded in the treatments of 2.5 % and 3.0 Potassium humate to mentioned characters. Application by 0.5 to 3.0 % of K- humate were increased plant height, stem diameter, number of leaves/plant, leaf area, root length and number of branches/plant, it ranged from 6.40 to 78.66%, 50.00 to 214.29 %, 20.94 to 249.80%, 21.84 to 128.33%, 17.08 to 125.63% and 41.18to 358.82%, respectively, than the corresponding values of the control plants. Application by 0.5 to 3.0 % of k- humate were increased fresh weight of leaves, stems and roots, it ranged from 1.68 to 30.97%, 15.06 to 112.49 and 22.96 to 121.85% respectively than control plants. All vegetative growth characters increased significantly by foliar application of humic acid compared with control, and the highest values were obtained at 3.0 % k-humate.Humic substances may play an important role in regulating the plant root metabolism by inducing the mechanism of protein synthesis, enzyme activation[11] of marigolds and peppers and number of fruits of strawberries.

Humic substances have a very pronounced influence on the growth of plant roots and enhance root initiation and increased root growth which known root stimulator[4]. humic acids may primarily increase root growth by increasing cell elongation or root cell membrane permeability, therefore increased water uptake by increased plant roots[12].

Effect of potassium humate on chemical constituents:

Pigments content:

Data in Table (4, 5) show that application of potassium humate affected the chl a,b and carotenoids were gradually increased by increasing the concentration of k-humate to 3.0 % than the control plant. The

highest increases were recorded in the treatments of 2.5 and 3.0 % k- humate. Application by 3.0 % of k-humate were increased chl a, b and carotenoids contents. The increments were 215.86, 113.07 and 53.62 %, respectively, compared with control plants.

Total carbohydrates:

potassium humate affected carbohydrates content were gradually increased by increasing k-humate from 0.5 to 3.0 % in leaves, stems and roots, the increases ranged from(10.42 to 105.09 %), (7.01 to 79.24%) and (5.05 to 68.73%) respectively than control plants. The highest values of chlorophyll a,b and carotenoids in leaves and carbohydrates content in leaves, stems and roots were recorded in plants sprayed with humic acid at 2.5 and 3.0%. Foliar application of k-humate increased carbohydrates content of *Thuja orientals* shoots, these increments due to the increases in chlorophyll a, b and carotenoids in leaves and might be lead to positive effects on growth parameters and increased total carbohydrates content[14].

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

Particle size distribution							**Field capacity (%)**
Sand (%)	**Silt (%)**		**Clay (%)**		**Soil texture**		
70.8	25.6		3.6		Sandy loam		20.1
Chemical properties							
Ecdsm-1	pH(1:25)		Caco3 (%)		O.M (%)		Soluble cobalt(ppm)
1.2	7.9		3.57		0.23		0.49
Soluble cations(meq-1)				Soluble Anions(meq-1)			
Ca^{++}	Mg^{++}	K^{+}	Na^{+}	Co_3^{-}	Hco_3^{-}	Cl^{-}	So_4^{-}
2.4	2	0.162	1.87	-	1.5	0.65	4.28
Total N(mg/100g)		Available(mg/100g)		Available micronutrients(ppm)			
		P	K	Fe	Mn	Zn	Cu
15.1		13	21	4.47	2.61	1.44	4

Table (2): Effect of different rates of Potassium humate on some growth parameters of *Jatropha curcas* seedlings. (Average of two seasons).

Characters / Potassium humate %	**Plant height (cm)**	**Stem diameter (cm)**	**Leaves number/ plant**	**Leaf area (cm^2)**	**Root length (cm)**	**Branches number/ plant**
0	93.7	1.4	25.3	29.3	19.9	5.1
0.5	99.7	2.1	30.6	35.7	23.3	7.2
1.0	115.5	2.5	39.1	40.4	26.6	10.1
1.5	116.7	2.9	56.7	46.6	30.1	13.1
2.0	139.6	3.4	69.3	51.1	34.3	15.9
2.5	156.7	3.9	81.7	57.7	38.6	19.3
3.0	167.4	4.4	88.5	66.9	44.9	23.4
L.S.D at 5%	**4.1**	**0.2**	**3.7**	**4.1**	**2.1**	**2.5**

Table (3): Effect of different rates of Potassium humate on fresh and dry weight of leaves, stems and roots of *Jatropha curcas* seedlings (Average of two seasons).

Characters / Potassium humate %	Fresh weights (g)			Dry weights (g)		
	Leaves	Stems	Roots	Leaves	Stems	Roots
0	146.83	117.7	55.13	39.64	37.55	19.46
0.5	149.31	135.43	67.79	41.06	43.60	24.27
1.0	160.32	150.11	88.53	45.21	49.08	32.05
1.5	169.15	156.63	94.11	48.55	51.84	34.53
2.0	182.11	188.13	101.21	52.99	65.47	37.55
2.5	186.12	215.53	114.51	55.09	74.36	43.06
3.0	192.31	250.11	122.31	57.69	87.54	46.48
L.S. D. at 5%	**3.06**	**4.01**	**2.13**	**2.12**	**1.93**	**1.14**

Table (4): Effect of different rates of Potassium humate on chlorophyll (a), (b) and carotenoids (mg/g FW) in leaves of *Jatropha curcars* seedlings (Average of two seasons).

Characters / Potassium humate %	Chrorophyll (a)	Chlorophyll (b)	Carotenoids
0	0.391	0.176	0.235
0.5	0.441	0.195	0.239
1.0	0.455	0.217	0.251
1.5	0.671	0.234	0.267
2.0	0.761	0.246	0.317
2.5	1.112	0.267	0.335
3.0	1.235	0.375	0.361

Table (5): Effect of different rates of Potassium humate on total carbohydrates content (%D.W) in leaves, stems and roots of *Jatropha curcas* seedlings (Average of two seasons).

Characters / Potassium humate %	Total carbohydrates %		
	Leaves	Stems	Roots
0	25.13	29.63	33.61
0.5	27.75	31.71	35.31
1.0	31.64	32.51	37.61
1.5	37.75	36.41	40.11
2.0	41.65	43.35	44.75
2.5	47.11	50.12	53.31
3.0	51.54	53.11	56.71

Conclusion

From the previous results, it can be concluded that humic acid may recommended for promoted growth parameters and chemical constitutes of *Jatropha curcus L*. plants at 3.0% Potassium humate.

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