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Impact of Some Biofertilizers and Compost on Growth and Chemical Composition of *Jatropha curcas* L.

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Abstract: Pot experiments were carried out in the two seasons of 2011 and 2012 at Research and Production Station of National Research Center, Nubaria, Behaira Governorate, Egypt to study the effect of biofertilizers i.e. algae, microbien and phosphorien in addition to untreated plants as control on vegetative growth and some chemical constituents of *Jatropha curcus* L. seedlings. Algae, microbien and phosphorien as biofertilizes were added 5 cm^3/pot after 30 and 60 days after planting (DAP), or compost (peanut or Nile compost) at the rate of 200g/pot. Results showed that all treatments significantly promoted all growth parameters of *Jatropha* seedlings than control plants. The highest values of plant height stem diameter, number of leaves/plant and leaf area in seedling of *Jatropha* seedlings were obtained by application algae, microbien and compost. Compost gave the highest values of fresh and dry weight of leaves and roots. The same trend was noticed concerning chlorophyll a, b and caroteniods contents, as well as carbohydrate, total soluble indoles and total soluble phenols content due to algae, phosphorien, compost and microbien treatments, respectively. On the contrary, indoles and phenols content were decreased by compost application. It can be concluded that biofertilization (algae, microbien, phosphorien or compost) application had safe of agricultural treatments to hazard the undesirable impact of mineral fertilizers, also it had a favorable effect on growth and favorable effect on growth and availability of chemical composition of *Jatropha curcus* L. seedlings.

Key words: *Jatropha curcus* L. · Algae · Microbien · Phosphorien · Compost

INTRODUCTION

Jatropha is a genus of approximately 175 succulent's plants. *Jatropha* is a poisonous, semi evergreen shrubs or small tree, its height reached 6 m with spreading branches and stubby twigs, leaves deciduous, alternate but apically crowded, ovate, a cute to acuminate, petioles 2.5-7.5 cm, flowers in cymes. It is resistant to a high degree or aridity, grow in desert. *Jatropha curcus* L. belongs to family Euphorbiaceae, its native to the American tropics, i.e. Mexico and Central America, cultivated in tropical and subtropical regions around the world. *Jatropha* the wonder plant produces seeds with oil content (27-40%) Achten *et al*. [1] average 34.4% Achten *et al*. [2] that can be processed to produce high quality biodiesel engine, the oil has been used for illumination, soap, candles [3]. List it for homicide, pesticide and raticide as well. The products are press cake a good organic fertilizer. Medically it is use for diseases like cancer, piles, snakebite, paralysis etc [3]. In recent years, the safe agricultural is one of the attitudes in the world [4]. Also, recently there has been an increasing awareness of the undesirable impact of mineral fertilizers on the environment, as well as potentially dangerous effects of chemical residues in plant tissues on the health of human and animal consumers. Inoculation and plant growth parameters, induced by specific rhizobia species, these was proved by Mazhar and El-Mesiry [5] on *Leucaena leucocphala* and Turky *et al*. [6] on *Foenicwum vulgare*. Nasef *et al*. [7] reported that the application of N at different levels and inoculation with biofertilizer led to on an increase in total porosity improves soil aggregation and possible moving salt soil under irrigation water. Balabel [8] reported that inoculating Orthoclase with *Bacillus circulans* (SDB) gave better effects on all vegetative growth and yield attributes, they also indicated that these effects were reflected on N, P and K content of tubers. El-Banna [9] indicated that using *Bacillus circulans* gave rise to increase the vegetative growth characters. Considering the effect of *Bacillus*

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megatherium inoculation, previous studies have indicated that phosphorus deficiency is one of the most important factors limiting plant growth. Luheurte and Barthelin [10] found that plant development as rat stimulated by inoculation with *Bacillus megatherium* in a soluble P deficient medium and root growth significantly increased by inoculation of maize plant with *Bacillus megatherium* for 5 ppm of soluble P. The effect of bacterial inoculation on growth of plants depends on the available amount of P present in the soil. On the other hand, increasing microbial actives in the rhizosphere raised available nutrients content in soil and plays special role by decomposing organic substances or transforming inorganic substances to available nutrients for plant growth and pH of all soils. The role of microorganisms in the production of forms of phosphorus (P) which are available to plants, have been examined by Oberson *et al*. [11] reported that a high positive correlation between phosphorus activity and residual P.

Algae are considered as an important group of microorganisms capable of fixing atmospheric nitrogen, However extracts of algae naturally contain auxins, cytokinins and gibberellic acid [12]. Auxins and cytokinins are known to stimulate establishment and elongation rate of root hairs and increase their number and gibberellins promote lateral growth [13] Abd-El Maguid *et al*. [14] stated that application algae increased vegetative growth of coratina olive transplants. Gobara [15] on palms and Hegab *et al*. [16] on orange trees reported that foliar application of algae extract considerably improved the leaf area of palms and orange trees and increased content of N in leaves of palm trees.

Organic manure (compost), addition could be reputed to increase the organic content in the soil, resulting in more release substances such as compost (commercial product, preparing from recycling the plant residues) [17]. Composting of agricultural residues by supplying newly reclaimed areas with their requirements of inorganic nutrients such as nitrogen and phosphorus and applying proper moistening and turning resulted in the final product with high ability to improve soils and enhance plant growth [18]. From the microbiological point of view, green manure has two main positive effects, i.e. it provides nutrient rich in organic carbon for the microbial biomass, which converts unavailable nutrients in plant residues to ones available for crops at it enhances biodiversity of soil microorganisms. This positive effect on soil microbial populations can be increased by interesting different green manure selections in crop rotation programs [19].

The main objective of this study was to investigate the effect of organic fertilizers and biofertilizers on growth and chemical constituents of *Jatropha curcas* L.

MATERIALS AND METHODS

The study was carried out at the Research and Production Station of National Research Centre, Nubaria, Behaira Governorate, Egypt during tow successive seasons of 2011 and 2012. The main objective of this study was to investigate the effect of organic fertilizer and biofertilizers on growth and chemical constituents of *Jatropha curcus* L. The physical and chemical properties of the soil site 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 Center, Giza, Egypt. The seedlings were planted on the 15th of March in plastic pots 30cm diameter, one plants/pot, the average height of seedlings were 15-20 cm, each pot filled with 10 kg from sandy soil. Complete randomized design with 6 treatments in 6 replicates was laid out in the two successive seasons.

Each pot was fertilized twice with 1.5 g nitrogen as ammonium nitrate (33.5%) and 2.0 g potassium as potassium sulphate (48.5% K_2O). The fertilizers were applied at 30 and 60 days after panting. Phosphorus as calcium superphosphate (15.5% P_2O_5) was mixed with soil before planting at 3.0 g/pot. Other agricultural processes were performed according to normal practice. The biofertilizer microbien was added to soil as fresh inocula mainly prepared by biofertilizer Lab. (Ministry of Agriculture, Egypt) 0 and 5 cm^3/pot and applied at 30 and 60 days after planting (DAP).

Table 1: Physical and chemical properties of the soil site

Properties		Values
Physical analysis		
Sand (%)		90. 11
Silt (%)		30.20
Clay (%)		6.64
Texture		Sandy
Chemical analysis		
pH 1:2.5		7.85
EC dS/m		0.24
O.M%		0.3
Ca^{++}	(meq/100g soil)	0.76
Mg^{++}	(meq/100g soil)	0.23
Na^{+}	(meq/100g soil)	1.14
K^{+}	(meq/100g soil)	0.29
Cl^{-}	(meq/100g soil)	0.61
HCO_3^{-}	(meq/100g soil)	1.39
SO_4^{--}	(meq/100g soil)	0.26
CO_3^{--}	(meq/100g soil)	--

Table 2a: Chemical properties of Nile compost used in study

	Macronutrients (%)			Macronutrients (ppm)						
Nil compost	N	P	K	Fe	Mn	Zn	Cu	pH	C/N	OM%
	1.35	0.52	0.85	161	310	61	35	7.5	14.1	13.29

Table 2b: Chemical properties of peanut compost used in study

	Macronutrients (%)			Macronutrients ppm						
Peanut compost	N	P	K	Fe	Mn	Zn	Cu	pH	C/N	OM%
	1.4	1.6	2.7	30.0	9	11.6	21.1	6.5	25.84	32.9

Phosphorien (*Bacillus megatherium*) phosphorus dissolving bacteria produced by Ministry of Agriculture, Egypt, Biofertilizer Lab at 0 to 5cm^3/pot and was applied at 30 and 60 DAP. Algae extract at 5 cm^3/pot (Algaefert) was mixed with the soil during experimental preparation. The compost fertilizer was mixed well with the soil during preparation at the rate of 200g/pot. The following data were recorded at the end of the month of October, stem length (cm), stem diameter (cm), number of leaves/plant, leaf area (cm^2) and fresh and dry weight (g) of plant organs and root length (cm). The following chemical analysis was determined in leaves chlorophyll a, b and carotenoids contents were determined according to Saric *et al*. [20]. Total carbohydrates percentages were determined according to Dubios *et al*. [21] the total indoles were determined in the methanolic extract, using dimethyl amino benzaldhyde test (Erlic's reagent, according to Larsen *et al.* [22] and modified by Salim *et al* [23]). Total soluble phenols were determined colorimetrically by using Folin Ciocalta reagent AOAC [24].

Statistical Analysis: The obtained results was subjected to the statistical analysis of variance according to the method described by Sendecor and Cochran [25] and the combined analysis of the two seasons was calculated according to the method of Steel and Torrie [26].

RESULTS AND DISCUSSION

Effect of Some Biofertilizers and Compost on Vegetative Growth: Data presented in Table 3 indicated that all treatments used increased all growth parameters of *Jatropha* seedlings, the highest increments of these parameters were obtained by algae, microbien and phosphorin than untreated plants. Concerning the effect of algae significantly exceeded plant height, stem diameter, number of leaves and leaf area by 39.25, 67.14, 162.86 and 115.45%, respectively than the corresponding values of the control plants. Similar conclusions were obtained by Abd-El Maguid *et al*. [14] on olive. Crouch and Van Standen [12] reported that algae naturally contain auxins, such as cytokinin and gibberellic acid, these are stimulate establishment and elongation root hairs and increase their number and GA_3 promote lateral growth [13], the importance of plant roots in affecting uptake of ions, which affective root diameter and expand the absorbing surface, the nutrient uptake by plant roots would be improved growth and yield. Microbien significantly exceeded the same aforementioned character by 23.11, 34.76, 62.86 and 33.05%. Microbien encouraged plant height, increased number of leaves/plant and increased root length; these results are in agreement with those obtained by Mazher [27] on *Parkinsonia aculeata* L. The previous characters increased significantly by phosphorien application, this may be due to the increase in nitrogen content in the soil as result of N fixation and phosphorus from phosphate dissolving bacteria, as well as growth promoting substances such as indole acetic acid and gibberellins produced by organisms used [28]. It is also obvious that *Jatropha* seedlings treated with peanut compost, significantly increased stem diameter, leaf area and root length by 57.14, 126.5 and 112.9%, respectively over control plants, Nile compost significantly exceeded the same characters by 48.0, 109.2 and 94.9%, respectively than the control.

Data presented in Table 4 showed that algae, Nile compost, peanut compost were increased significantly promoted fresh and dry weights of leaves and roots than control plants. Concerning the effect of compost significantly increased all growth parameters, fresh and dry weights of leaves and roots (Tables 3 and 4) demonstrated clearly that using biofertilizers algae, microbien, phosphorine and compost each alone had a positive effect on the a aforementioned growth characters. This might be related to the improvement of physical conditions of soil provided energy for micro organisms activity and increase the availability and uptake of N, P and K, which was reflected on growth [29, 30].

Table 3: Effect of some biofertilizers and compost on plant height (cm), stem diameter (cm), number of leaves/plant, leaf area (cm^2) and roots length (cm) of Jatropha curcas seedlings in sandy soil.

Treatments	Characters				
	Plant height (cm)	Root length (cm)	Stem diameter (cm)	Number of leaves/plant	Leaf area (cm^2)
0	110.30	17.80	2.10	23.70	37.33
Microbien	135.80	25.70	2.83	38.60	49.67
Phosphorien	126.30	32.10	2.75	33.70	59.31
Algae	153.60	39.60	3.51	62.30	80.43
Compost (1)	115.60	34.70	3.11	49.60	71.67
Compost (2)	119.90	37.10	3.30	53.30	75.53
L.S.D at 5%	4.02	2.00	0.09	1.50	3.41

Compost (1) = Nile compost Compost (2) =Peanut compost

Table 4: Effect of some biofertilizers and compost on leaves and roots fresh and dry weight (g) of *Jatropha curcas* seedlings in sandy soil.

Treatments	Characters			
	Leaves fresh weight (g)	Leaves dry weight (g)	Root fresh weight (g)	Root dry weight (g)
0	136.75	31.72	67.50	20.31
Microbien	153.73	40.31	75.31	28.53
Phosphorien	148.71	35.15	78.15	33.34
Algae	175.67	52.77	110.13	46.01
Compost (1)	167.75	46.67	95.15	36.71
Compost (2)	161.33	43.36	101.25	41.61
L.S.D at 5%	4.13	2.81	3.02	1.81

Compost (1) = Nile compost Compost (2) =Peanut compost

Table 5: Effect of some biofertilizers and compost on chlorophyll a, b and carotenoids (mg/gm F.W) in leaves of *Jatropha curcas* seedlings in sandy soil.

Treatments	Characters		
	Chlorophyll a	Chlorophyll b	Carotenoids
0	0.314	0.183	0.213
Microbien	0.983	0.435	0.391
Phosphorien	1.035	0.556	0.467
Algae	1.226	0.673	0.577
Compost(1)	0.675	0.317	0.311
Compost(2)	0.677	0.374	0.325

Compost (1)= Nile compost Compost (2)=Peanut compost

Eeffect of Some Biofertilizers and Compost on Chlorophylls and Total Carbohydrates

Photosynthetic Pigments: Data presented in Tables 5 and 6 indicated that application with algae, phosphorine, microbien and compost significantly affected the photosynthetic pigments content of *Jatropha* leaves. Data also emphasized that chlorophyll a, chlorophyll b and total carotenoids were significantly increased when seedlings treated with algae, phosphorien, microbien and compost. The highest values of these parameters were obtained in seedlings treated with algae, phosphorien and microbien, respectively compared to control plants. These results are in agreement with those obtained by Wroble and Wolniak [31]; they reported that chlorophyll a, b and carotenoids were increased in *Salix viminals* L. plants with biostimulator application. Total carbohydrates content significantly increased in leaves and roots of *Jatropha* seedlings treated with phosphorien, microbien and algae. Whereas, compost gave the lowest values of carbohydrates content compared with control plants or in other treatments. Such increment in photosynthetic pigments, which reflect in photosynthesis processes and led to increase in carbohydrate contents. These results are in agreement with those reported by Elham [32], who reported that the effect of biofertilizers and compost on yield and quality of sugar beet, she found that using organic fertilizer caused significantly increased in yield and sugar yield/fed, as well as vegetative growth and biological yield.

Total Indoles: according to the data illustrated in Table 6 the total indole levels were determined in shoots and roots of *Jatropha* seedlings were highly significantly affected by the application of algae, microbien and phosphorien, total indoles in shoots was increased by 85.04, 66.35 and 64.48%, respectively than control plants. Whereas, indoles in *Jatropha* shoots were decreased by 20.56 and 9.34% with application of Nile and Peanut compost, respectively than the control plants. Total indoles in roots of *Jatropha* seedlings were highly

Table 6: Effect of some biofertilizers and compost on total carbohydrates content (% D.W), indoles (mg/g F.W) and phenols (mg/g F.W) in leaves and roots of *Jatropha curcas* seedlings in sandy soil.

	Characters					
	Total carbohydrates%		Indoles		Phenols	
Treatments	Leaves	Root	Shoot	Root	Shoot	Root
0	19.31	27.33	1.07	1.35	1.17	1.25
Microbien	30.35	37.35	1.76	1.97	1.45	1.55
Phosphorien	35.17	40.67	1.78	1.90	1.56	1.73
Algae	27.67	33.36	1.98	2.31	1.76	1.98
Compost(1)	27.11	31.74	0.85	1.15	1.08	1.23
Compost(2)	25.41	28.83	0.97	1.27	1.11	1.29

Compost (1) = Nile compost Compost (2) =Peanut compost

significantly affected by algae, microbien and phosphorien treatments, which increased by 71.11, 45.92 and 40.74%, respectively than the control plants, whereas indoles in roots were decreased by 14.81 and 5.92%, respectively than control plants. Subba [33] reported that microorganisms have important role in nitrogen fixation, also well documented the ability to synthesize indole acetic acid and gibberellins like substances, which gave additional advantages in the field bio- production.

Total Soluble Phenols: The results in Table 6 emphasized that the amounts of total soluble phenols in shoots were highly significantly influenced by algae, phosphorien and microbien, which increased by 50.24, 33.33 and 23.93%, respectively than control plants, while, total soluble phenols content in *Jatropha* shoots were decreased by 7.69 and 5.12%, respectively than control plants due to application of Nile and Peanut compost. Total phenol in roots of *Jatropha* seedlings were highly significantly affected by algae, phosphorien and microbien treatments, which increased by 58.40, 38.40 and 24.00%, respectively than the control plants, whereas total phenols in roots were decreased significantly by 106% due to Nile compost application.

It can be concluded that biofertilizer and compost application had safe of agricultural treatments to hazard the undesirable impact of mineral fertilizers and had a favorable effect on growth and availability of chemical composition of *Jatropha curcus* L. seedling.

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