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Effect of Indole Acetic Acid on Growth, Yield, Nutrients Content and Some Physiological Compositions of Bean under Different Rates of Compost

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ABSTRACT

The experiment was conducted in 2014 season at El-Ayat, Giza governorate. The experiment was designed to investigate effect of Indole Acetic Acid (IAA) and compost on growth, yield, nutrients content and some physiological compositions of bean (*Phaseolus vulgaris* L.). Four rates of IAA(0, 75, 150 and 225 ppm) combined with four rates of compost (0, 0.5, 1 and 1.5 ton fed^{-1}).

Number of leaves and pod, leaf area and pod yield were increased when the rate of IAA increased under all rates of compost. High value of pod yield (6.47 ton fed^{-1}) was obtained it when add high level for each of the compost (1.5 ton fed^{-1}) and IAA (225 ppm). Nitrogen, phosphorus and potassium content of leaves increased when the rates of IAA and compost increased. The high value of N, P and K content of leaves were obtained under high rates of IAA and compost (225 ppm + 1.5 ton fed^{-1}, respectively). As well as increasing the values of soluble protein and total carbohydrates of leaves under high rates of IAA and compost.

KEY WORDS: Indol Acetic Acid (IAA), Compost, Bean, Growth, Yield, N, P and K content, physiological compositions

INTRODUCTION

Beans are considered the most important family leguminous crops desired Egyptian consumer, which joined a great success in export markets. Beans are grown for the purpose of domestic marketing or export whether it is for the consumption of green pods called snap beans or consumption of dry seeds called dry beans.

Composting can be defined as being the breakdown of organic materials by large numbers of microorganisms in a moist, warm, aerated environment, leading to the production of carbon dioxide, water, minerals and a stabilized organic matter **(Diaz *et al*., 2002)**. Composting is the biochemical degradation of organic materials to a sanitary, nuisance-free, humus-like material. Composting has been defined as a controlled-microbial aerobic decomposition process with the formation of stabilized organic materials that may be used as soil conditions and/or organic fertilizers **(Negro *et al*., 1999)**.**Taalab and Aziz (2004)** reported that available nitrogen and potassium in field plots that received organic materials was higher than those treated with chemical fertilizer. The rate of increases in the mean availability of potassium in plots treated with farmyard manure, tomato compost and farmyard manure combined with tomato compost were 23, 36 and 38% as compared with chemical fertilizer treatment, respectively. **Rodrgues *et al* (2002)** reported that compost with an adequate amount of chemical N fertilizer could reach a high dry matter yield and a high level of Naccumulation, even higher than those recommended for the conventional chemical N fertilizer treatment.

Plant growth regulators (PGRs), either produced naturally by the plant or synthetically by a chemist, are small organic molecules that act inside the plant cells and alter the growth and development of plants. IAA is a naturalauxin; one of its primary effects is activation of the plasmalemmal H+-ATPase involved in the process of growth by elongation. This process could be considered as aromorphosis providing for an economic and rapid usage of basic resources of nutrition (light energy and mineral nutrients) **(Tarakhovskaya *et al*., 2007)**. Indole-3-acetic acid (IAA) showed beneficial effect on flower retention and subsequently on yield of lentil **(Khalil *et al*., 2006)**.

The aim of this study was conducted to find out the effect of IAA on growth, yield, N, P and K content and some physiological compositions of bean under different rates of compost.

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MATERIALS AND METHODS

This investigation was carried through 2014 season on bean (*Phaseolus vulgaris* L.) at El-Ayat, Giza governorate. The field experiment was sampled before bean planting to determine some chemical and physical properties of soil according to the standard procedures outlined by **Cottenie (1980)** (Table, 1).

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

Soil property	Value	Soil property	Value
Particle size distribution %		pH (1:2.5 soil suspension)	8.1
Sand	21.6	ECe (dS m^{-1})	0.89
Silt	20.4	Soluble ions (meq L^{-1})	
Clay	58	Ca^{++}	3.77
Texture	Clay	Mg^{++}	3.27
		Na^{+}	1.3
		K^{+}	0.56
Organic matter%	2.20	CO_3^{--}	nd*
Available N (mg kg^{-1})	19.6	HCO_3^{-}	4.0
Available P (mg kg^{-1})	4.81	Cl^{-}	1.1
Available K (mg kg^{-1})	116.9	SO_4^{--}	3.8

Four rates of IAA (0, 75, 150 and 225 ppm) combined with four rates of compost (0, 0.5, 1 and 1.5 ton fed^{-1}). Compost was added during the preparation of the soil for the cultivation of bean, but IAA was used as a foliar application for three times. Chemical properties of the compost were measured according to the standard methods described by **Cottenie (1980)** and shown in (Table, 2). Plant samples were collected from mature pepper plants at harvest stage for analysis. Plant samples were dried at 65C° for 48 hrs, ground and wet digested using H_2SO_4: H_2O_2 method **(Cottenie, 1980)**. The digests were then subjected to measurement of N using Micro-Kjeldahl method; P was assayed using molybdenum blue method, while, K was determined by Flame Photometer **(Chapman and Pratt, 1961)**.

Table, 2:Chemical properties of the compost (on dry weight basis).

	pH*	Organic Carbon	C/N ratio	N	P	K	Fe	Zn	Mn
		%			g kg^{-1}			mg kg^{-1}	
Compost	7.15	33.8	16:1	1.60	0.60	1.27	1748.8	60	125

* (1:2.5) compost: water suspension.

Total soluble protein in pods was determined according to **(Bradford, 1976)** and total carbohydrates in pods were measured according to **(A.O.A.C.).**

RESULTS AND DISCUSSION

Data presented in (Table, 3) showed the influence of different rates of IAA and compost on number of leaves and pod, leaf area and pod yield. Results indicated that all parameters were increased when the rate of IAA increased under all rates of compost. Encouraging impact of IAA was evident in the presence of compost and this effect is increased in the high rate of compost. High values of number of leaves and pod, leaf area and pod yield (26.0, 24.13,213.0 and 6.47, respectively) were obtained in high rates of compost (1.5 ton fed^{-1}) and IAA (225 ppm). Indole acetic acid is the main auxin in plants, controlling many important physiological processes including cell enlargement and division, tissue differentiation, and responses to light and gravity **(Shahab *et al.*, 2009)**.**Newaj *et al.*, (2002)**showed that application of IAA had significant effect on yield of mungbean, IAA at 600 ppm produced highest pod length, number of seeds per pod, seed yield per plant, 1000 seeds weight and seed yield (ton ha^{-1}) and as compared to other concentrations and control treatment. **Mervat *et al.*, (2013)** indicated that IAA treatments caused significant increases in seed yield/plant (g), seed yield/faddan (kg) and yield attributes (number of pods/plant, pods yield/plant (g), 100-seed weight (g) and biological yield/plant) of the two fababean cultivars. Furthermore, the highest values of seed yield were obtained from the application of 50 mg/lIAA +75 mg/l Kin treatment in the two cultivars.

Table, 3: Effect of different rates of IAA and compost on number of leaves and pod,leaf area and pod yield.

Treatments		Leaves number	Leaf area cm^2	Number of pods	Pod yield ton fed^{-1}
Compost (ton fed^{-1})	IAA (ppm)				
0	0	15.94	145.8	16.94	4.45
	75	17.81	152.4	18.19	4.82
	150	19.69	162.3	18.69	4.98
	225	21.19	180.0	21.06	5.42
0.5	0	17.94	160.4	18.50	4.92
	75	21.69	170.7	19.80	5.29
	150	22.19	179.8	21.00	5.47
	225	22.50	196.0	22.19	5.68
1	0	23.12	170.1	20.94	5.22
	75	23.44	171.4	22.38	5.68
	150	23.31	181.5	22.94	5.90
	225	24.69	197.2	24.37	5.84
1.5	0	23.60	176.9	21.25	5.81
	75	25.31	184.9	22.81	6.07
	150	25.25	193.6	23.37	6.42
	225	26.00	213.0	24.13	6.47

Data in (Table,4) indicated that effect of IAA rates under different rates of compost on N, P and K content of leaves; the results showed that increasing leaves content of N, P and K when the rate of IAA and compost increased from 0 to 225 ppm and 0 to 1.5 ton fed^{-1} respectively. As well as N, P and K content of leaves increased when IAA rates increased under all rates of compost. The high value of N, P and K content of leaves (2.45, 0.144 and 3.78 % respectively) were obtained under high rate of IAA and compost (225 ppm + 1.5 ton fed^{-1},respectively). **Abd El-Rheem *et al*., (2015)** showed that the rate of IAA (150ppm) enough to obtain high value of N, P and K content in leaves of wheat under different rates of N fertilization. Within reason the cellulose in plant residues, returning this material as compost reduces the bulk density, promotes the formation of soil aggregate structure, and increases the efficiency of water in soil **(Tejada and Gonzalez, 2006)**. There were certain amount of carbohydrate, N, P, K, and other nutrients in residues, the compost applied to soil was transferred to organic matter and improved the soil fertility **(Ribeiro *et al*., 2007; Roca-Pérez *et al*., 2009)**. Inasmuch the increase in the organic matter content and improvement of the physical-chemical properties, residue returned as compost supplies a better soil environment and an abundant carbohydrate and nitrogen source that benefits the growth of beneficial microorganisms **(Ros *et al*., 2006; Bougnom *et al*., 2010)**. Therefore, residue returned as compost results in enhanced soilenzyme activity by increasing the amount of enzymes and their substrates in the soil **(Ros *et al*., 2006)**.

Table, 4: Effect of rates of IAA and compost on N, P and K content of leaves.

Treatments		N	P	K
Compost (ton fed^{-1})	IAA (ppm)		%	
0	0	2.13	0.110	3.18
	75	2.13	0.121	3.37
	150	2.18	0.121	3.39
	225	2.19	0.122	3.23
0.5	0	2.19	0.122	3.30
	75	2.28	0.126	3.36
	150	2.29	0.126	3.37
	225	2.32	0.131	3.44
1	0	2.31	0.130	3.47
	75	2.34	0.135	3.53
	150	2.38	0.132	3.72
	225	2.39	0.132	3.69
1.5	0	2.39	0.131	3.69
	75	2.39	0.140	3.71
	150	2.44	0.140	3.78
	225	2.45	0.144	3.78

Data in (Table, 5) indicated that effect of IAA rates under different rates of compost on soluble protein and total carbohydrates of leaves. The results showed that increasing values of soluble protein and total carbohydrates of

leaves with increasing IAA and compost rates, ,especially, under high rates of IAA (225 ppm) and compost (1.5 ton fed^{-1}).IAA pays an active role in plant development by improving photosynthetic and activities of spreading leaves in plant. Indole-3-acetic acid (IAA) is the main auxin in plants, controlling many important physiological processes including cell enlargement and division, tissue differentiation, and responses to light and gravity. It also starts the movement of carbohydrates during their manufacture **(Awan *et al*., 1999). Abd El-Rheem *et al*., (2015)** studied the effect of different rates of indole acetic acid on some physiological properties of wheat plants under different rate nitrogen fertilization. They found that Increasing IAA rates from 75 to 300 ppm under different rates of N fertilization increased chlorophyll a, chlorophyll b, carotenoid, protein and carbohydrate. High level of nitrogen fertilization (120 kg N fed^{-1}) and IAA (300 ppm) gave high value of chlorophyll a, chlorophyll b, carotenoid and protein but the second level of IAA (150) under high level of N fertilization (120 kg N fed^{-1}) was enough to obtain high value of carbohydrate.

Table, 5: effect of rates of IAA and compost on soluble protein and total carbohydrates of leaves

Treatments		Soluble Protein	Total Carbohydrates
Compost (ton fed^{-1})	IAA (ppm)	mg 100 mg DW^{-1}	
0	0	1.69	20.61
	75	1.74	20.80
	150	1.72	21.42
	225	1.85	22.18
0.5	0	2.01	21.16
	75	2.07	21.51
	150	2.18	22.84
	225	2.21	23.93
1	0	2.16	25.38
	75	2.13	25.51
	150	2.37	25.63
	225	2.33	25.85
1.5	0	2.29	26.53
	75	2.20	26.85
	150	2.38	26.52
	225	2.45	26.63

Conclusion:

Based on these results, it could be concluded that high rate of both IAA (225 ppm) and compost (1.5 kg fed^{-1}) given high value of number of leaves and pod, leaf area, pod yield, N, P and K content, soluble protein and total carbohydrates of leaves of bean plants.

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