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## **Response green bean plants growth, yield and nutritional status to foliar application of cytokinin under compost amendment**

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**Abstract**--The study was carried out during 2018 and 2019 seasons, on green bean (*Phaseolus vulgaris* L.) plants at private farm- El-Ayat, Giza governorate. The experiments were designed to study the effect of various rates of compost (0, 2, 4 and 6 ton fed<sup>-1</sup>) and different concentrations of cytokinin (0, 50, 100 and 150ppm) on growth, yield parameters and nutritional state of green bean plants. The results indicate that the addition of compost at a rate of 6 ton fed<sup>-1</sup> along with spraying of cytokinin at a concentration of 150 ppm led to the improvement of the growth and yield characteristics as well as obtaining the highest value of these characteristics compared to other experimental treatments. The same thing with the increase of compost additives and the concentration of cytokinin spray contributed greatly to improving the quality of the green bean crop, especially the content of protein, carbohydrates and fibers. With the same flow, the treatment of green beans with 6 ton fed<sup>-1</sup> and spraying them with a higher rate of cytokinin (150 ppm) increased the nitrogen, phosphorous and potassium content of the leaves in both growing seasons. Through the results obtained, we can emphasize the importance of using fully ripe organic fertilizers, especially compost, as well as the effective role of cytokinin in obtaining a high yield of green beans is evident.

**Keywords**---Green bean, Growth, Yield, Nutritional status, Compost, Cytokinin.

## Introduction

Bean (*Phaseolus vulgaris*, L.) is one of the utmost remarkable members of leguminous harvests in Egypt grown for either domestic exhaustion or exportation, it is famous as green bean or snap bean it is important fountain for protein and energy for plentiful nations. It's rich in protein, dietary fibers, nutrients and vitamins.

Compost use is one of the ultimate prominence agents, which pool to boost productivity of crops. Compost is able to fix the problem faced on farmers with lowering fertility of their soil (Madeleine *et al.*, 2005). Brown and Cotton (2011) suggested that soils fertilized with compost contained highest concentrations of plant available nutrients compared to conventionally fertilized soils. Using compost did not only amend the productivity of yields in terms of quantity but it was increasing the quality of products is influenced in an affirmative way (Soheil *et al.*, 2012).

Cytokinins are plant hormones known as key regulator of plant growth, including cell division, chloroplast biogenesis, bud and root differentiation, shoot meristem initiation and growth and stress tolerance (Kuroha *et al.*, 2009). As well as cytokinin played an important role in regulating tiller bud growth and grain filling in alternate waiting and drying irrigation system (Liu *et al.*, 2011). The aim of this study was conducted to find out the effect of spraying cytokinin on growth, yield quantity and quality and nutritional state of green bean under different rates of compost.

## Material and Methods

This investigation was carried through 2018 and 2019 seasons on green bean (*Phaseolus vulgaris* L.) at private farm- El-Ayat, Giza governorate. The soil 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)	8.20
Sand	21.6	EC (dS m <sup>-1</sup> ), soil paste extract	0.89
Silt	20.4	Soluble ions (mmol L <sup>-1</sup> )	
Clay	58	Ca <sup>++</sup>	3.77
Texture	Clay	Mg <sup>++</sup>	3.27
CaCO <sub>3</sub> %	0.80	Na <sup>+</sup>	1.3
Saturation percent %	23.30	K <sup>+</sup>	0.56
Organic matter %	2.10	CO <sub>3</sub> <sup>-</sup>	nd*
Available N (mg kg <sup>-1</sup> )	19.8	HCO <sub>3</sub> <sup>-</sup>	4.0
Available P (mg kg <sup>-1</sup> )	3.90	Cl <sup>-</sup>	1.1
		SO <sub>4</sub> <sup>-</sup>	3.8
Available K (mg kg <sup>-1</sup> )	96.6		

Four rates of cytokinin (0, 50, 100 and 150 ppm) combined with four rates of compost (0, 2, 4 and 6 ton fed<sup>-1</sup>). Compost was added during the preparation of the soil for the cultivation of green bean, but cytokinin was used as a foliar application for three times (the first before flowering, 15 and 30 days after the first one). 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 green bean plants at harvest stage for analysis. Plant samples were dried at 65°C for 48 hrs, ground and wet digested using H<sub>2</sub>SO<sub>4</sub>: H<sub>2</sub>O<sub>2</sub> 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 <sup>-1</sup>			mg kg <sup>-1</sup>		
Compost	7.15	33.8	16:1	1.60	0.40	0.98	180.8	50	66.5

\* (1:2.5) compost: water suspension.

Total protein in pods was determined according to (Bradford, 1976) and total carbohydrates in pods were measured according to (A.O.A.C.). Fiber percentage in pods determined according to (Rai and Mudgal, 1988). Data of the two seasons were arranged and statistically analyzed using Mstastic (M.S.) software. The comparison among means of the different treatments was determined, as illustrated by Snedecor and Cochran (1982).

## Results and Discussion

Data presented in Table (3) show the influence of different rates of compost and concentrations of cytokinin on plant height, leaves number, leaf area, plant dry weight, pod length, pods number and pod yield of green bean during 2018 and 2019 seasons. The vegetative outgrowth and yield of green bean responded positively to compost rates. The best organic fertilization rate, which gave the highest measurements of growth and yield, was 6 ton fed<sup>-1</sup> during the two growing seasons. As for the effect of spraying with different concentrations of cytokinin on the growth and yield of bean, it was observed that by increasing the spray concentration from 0 to 150 ppm, it significantly improved the growth and yield of green bean plants during the two growing seasons, which demonstrates the effective role of cytokinin in enhancing the yield characteristics of leguminous plants. The spraying of cytokinin with its different concentrations in the presence of the terrestrial additives of vermicompost had a great positive action on the growth and yield characteristics. As the spraying of cytokinin at a concentration of 150 ppm with the use of 6 ton fed<sup>-1</sup> of vermicompost led to the largest increase in all the growth and yield characteristics of green beans in the two growing seasons.

Table (3)  
Effect of cytokinin foliar application and compost treatments on growth and yield of green bean during 2018 and 2019 seasons

Compost ton fed <sup>-1</sup>	Cytokinin ppm	Plant height cm	No. of leaves	Leaf area cm	Plant dry weight g	Pod length cm	No. of pods	Pod yield ton fed <sup>-1</sup>
1 <sup>st</sup> season								
2	0	36.0	18.92	162.2	14.68	12.0	17.50	4.50
	50	41.0	22.78	172.7	19.05	12.9	19.13	5.07
	100	50.2	23.30	180.8	20.78	13.1	20.13	5.26
	150	50.5	23.60	197.1	20.87	13.5	21.50	5.47
4	0	36.1	20.60	166.4	16.05	12.9	20.38	5.01
	50	41.0	24.54	173.1	18.50	13.5	22.13	5.36
	100	50.2	24.56	183.2	19.58	13.7	22.63	5.79
	150	50.6	25.78	196.2	20.91	14.0	24.00	5.62
6	0	36.2	22.20	170.0	17.47	13.2	21.25	5.55
	50	42.0	26.30	185.5	21.08	14.0	23.13	5.88
	100	52.5	26.42	194.4	21.81	14.2	23.50	6.27
	150	53.2	27.00	199.5	22.99	14.8	24.13	6.31
2 <sup>nd</sup> season								
2	0	35.0	18.89	160.0	14.60	11.8	17.4	4.49
	50	41.2	22.77	170.8	18.90	12.7	19.20	5.00
	100	49.5	23.10	180.8	20.77	12.9	20.10	5.19
	150	50.2	23.52	195.1	20.70	13.4	21.40	5.37
4	0	36.2	20.70	162.5	15.80	12.8	20.40	5.00
	50	41.2	24.40	170.2	18.92	13.2	22.10	5.33
	100	50.1	24.61	182.8	19.42	13.5	22.55	5.77
	150	50.5	25.66	190.2	20.85	13.9	23.94	5.55
6	0	37.0	22.00	166.0	16.60	12.9	21.20	5.50
	50	44.0	25.88	185.5	21.10	13.9	22.90	5.78
	100	50.3	26.00	192.2	21.70	14.1	23.22	6.18
	150	51.1	26.90	198.2	22.80	14.7	24.10	6.20
LSD <sub>0.05%</sub>		3.34	1.30	12.0	1.38	0.60	1.33	0.40

Addition of compost could be a way to ameliorate soil structure and airing and creating a best environment for plants outgrowth. The use of compost is a natural and ecological means of improving soil fertility for improved crop yield (Ouedraogo *et al.*, 2001 and Convertini *et al.*, 2004). Joshi *et al.*, (2009) showed that the highest bean yield was recorded by using compost at rates 6 and 8 ton per feddan.

Tecchio *et al.*, (2006) reported that the highest rates of relative growth rate and leaf area ratio were observed by using the cytokinin, fulfill in a greater development of plants. Cytokinins play a pivotal role in regulating the proliferation of plant cells, and the control of various processes in plant growth and development (Gajdošová *et al.*, 2011 and Schaller *et al.*, 2014)

Data presented in Table (4) show the effectiveness of different rates of compost treatments and different concentrations of cytokinin during 2018 and 2019 seasons on yield quality of green bean. Increasing compost rates from 2 to 6 ton fed<sup>-1</sup> were enhancing total carbohydrate and protein except for fiber content of pods bean. However, by increasing the concentration of spraying cytokinin, it did not significantly affect both carbohydrates and protein in the pods of bean, and the effect of low concentration of cytokinin had an effect in increasing the seed content of fibres.

Cytokinins are involved in the development of cellular structures and in the enzymatic vigor regulating the activation of the protein synthesis necessary for the formation of the photosynthetic system (Chernyad, 2005 and Chiappetta *et al.*, 2006). Cytokinins are regulate root architecture, acting to inhibit lateral root initiation, and they can adjust root function by regulating the expression of nutrient transport (Argueso *et al.*, 2009 and Werner *et al.*, 2010). Abou El-Yazied *et al.*, (2012) indicated that fiber percentages in pods of bean have no significant difference when increasing compost treatments.

Shafeek *et al.*, (2003) showed that increasing compost rate up to 40 m<sup>3</sup> fed<sup>-1</sup> led to increasing seed yield and the highest values of crude protein of radish plants. As well as, using compost fertilizer led to increasing carbohydrate content in turnip roots (El-Sherbeny *et al.*, 2012).

Table (4)  
Effect of cytokinin foliar application and compost treatments on yield quality of green bean during 2018 and 2019 seasons

Compost ton fed <sup>-1</sup>	Cytokinin ppm	1 <sup>st</sup> season			2 <sup>nd</sup> season		
		Total protein	Total carbohydrate	Fiber	Total protein	Total carbohydrate	Fiber
		%			%		
2	0	17.1	20.9	13.6	17.0	20.8	13.5
	50	19.7	21.6	13.7	19.6	21.5	13.7
	100	21.6	21.8	13.3	21.5	21.7	13.4
	150	20.9	23.7	13.4	20.8	22.8	13.5
4	0	18.0	21.0	13.2	17.8	20.9	13.1
	50	19.9	23.9	13.3	19.8	23.8	13.2
	100	20.7	25.4	12.8	20.6	25.5	12.7
	150	21.2	25.5	12.0	21.1	25.6	12.2
6	0	19.8	23.0	13.3	19.7	22.8	13.3
	50	20.3	26.5	12.8	20.2	26.4	12.8
	100	21.2	26.9	12.4	21.2	26.8	12.5
	150	21.0	26.7	11.9	21.1	26.7	12.0
LSD <sub>0.05%</sub>		0.38	1.33	0.46	0.38	1.33	0.46

Data presented in Table (5) show the leverage of different rates of compost treatments and different concentration of cytokinin during 2018 and 2019 seasons on N, P and K content of leaves. The bean leaf content of nitrogen, phosphorus and potassium increased when the compost rate was increased from

2 to 6 ton fed<sup>-1</sup> and also by increasing spraying of cytokinin from 0 to 150 ppm. The highest values were obtained from the content of nutrients when adding the high level of compost (6 ton fed<sup>-1</sup>) in the presence of cytokinin spray at a highest concentration than it (150 ppm).

Table (5)  
Effect of cytokinin foliar application and compost treatments on N, P and K content of leaves green bean during 2018 and 2019 seasons

Compost ton fed <sup>-1</sup>	Cytokinin ppm	1 <sup>st</sup> season			2 <sup>nd</sup> season		
		N	P	K	N	P	K
		%			%		
2	0	1.99	0.121	3.29	1.97	0.119	3.24
	50	2.18	0.125	3.33	2.17	0.124	3.29
	100	2.24	0.125	3.36	2.24	0.125	3.30
	150	2.31	0.126	3.37	2.30	0.126	3.32
4	0	2.01	0.130	3.32	2.00	0.128	3.30
	50	2.25	0.131	3.36	2.20	0.130	3.34
	100	2.26	0.134	3.40	2.25	0.131	3.40
	150	2.31	0.134	3.41	2.31	0.133	3.39
6	0	2.11	0.131	3.50	2.10	0.130	3.45
	50	2.30	0.135	3.52	2.29	0.134	3.50
	100	2.32	0.135	3.56	2.30	0.135	3.52
	150	2.33	0.136	3.64	2.31	0.136	3.60
LSD <sub>0.05%</sub>		0.02	0.05	0.33	0.02	0.05	0.33

Regardless of the thrift of nutrients available for plants by organic composts, nutrients transmutation during the decomposition of organic matter robustly interacts with nutrients uptake by plants (Khan *et al.*, 2013). The association between the internal mineral elements was largely affected by kinetin treatments, may also the kinetin role to reduce the injury of membranes and that improve nutrients uptake (Sarwat and El-Sherif, 2007). Barberaki and Kintzios (2002) reported that the accumulation of macronutrients in plant tissue cultivated in greatly affected by the presence of growth regulators.

## Conclusion

Paying attention to organic fertilizers, especially compost, helps green bean plants to grow well and have a bumper crop. The spraying of cytokinins greatly improves the yield and quality of the green bean crop.

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