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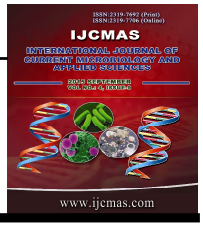

Original Research Article

Improving Growth and Productivity of Garlic Plants (*Allium sativum* L.) as Affected by the Addition of Organic Manure and Humic Acid Levels in Sandy Soil Conditions

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Keywords

Garlic plants, Nile compost, Humic acid, growth, Total bulbs yield, Bulb quality

A B S T R A C T

Two field experiments were carried out during the two seasons of 2013 and 2014 at the experimental station of National Research Centre, Beheira Governorate (North of Egypt) to investigate the effect of organic compost manure fertilizer at rates of (40, 80 and 120 kg N/fed.) as well as humic acid at rate of (0, 2 and 4 L/fed.) for influence plant growth, total bulbs yield, physical and chemical content of garlic plants c.v. Chinese. The important obtained results were as following: 1-Adding organic compost manure fertilizer (produced from recycling the agriculture residues) at high rates (120 kg N/fed.) had a significant effect on growth characters, i.e. plant length, number of leaves/plant, total chlorophyll contents, fresh and dry weight/plant as well as total bulbs yield and its components (fresh and dry weight of bulb, bulb diameter, number of cloves bulb and weight of cloves). Also, gave the highest percentage of protein, N, P and K. 2- By increasing rates of humic acid increased growth characters, total bulbs yield and its components and increment the percentage of protein, N, P and K, contents of garlic bulb tissues. 3- The highest values of the growth characters, total bulbs yield and its components as well as the percentage of protein, N, P and K content in garlic bulb tissues were associated with that plants received higher compost level (120 kg N\fed.) with higher level of humic acid (4 L/fed.).

Introduction

Garlic (*Allium sativum* L.) is one of the most important bulb vegetable crops and is next to onion (*Allium cepa)* in importance Hamma *et al.,* (2013). It is commonly used as a spice or in the medicinal purposes. In Egypt, it has been generally cultivated for both local consumption and export. Egypt ranks the fourth leading country in the world for garlic production (244.626 MT) after China, India and Korea (FAO, 2011).

The economic importance of the garlic crop has increased considerably in the entire world in recent years.

Therefore, increasing garlic yield and improving bulb quality are essential aim for both growers and consumers, but it usually depends on many factors especially that influence the plant growth throughout the growth period. Growing garlic in the newly

reclaimed soils is faced by various problems, such as low amounts of available nutrients and poor organic matter content as well as poor hydrophsic, chemical and biological properties.

Organic manures improve chemical, physical and physiochemical properties of soil. Also, excessive amounts of inorganic fertilizers are applied to vegetables in order to achieve a higher yield (Stewart *et al.,* 2005) and maximum value of growth, (Dauda *et al.,* 2008).However, the use of inorganic fertilizers alone may cause problems for human health and the environment (Arisha and Bardisi, 1999). Organic manure can serve as alternative practice to mineral fertilizers (Naeem *et al.,* 2006) for improving soil structure and microbial biomass (Suresh *etal*., 2004). Moreover, these changes improve soil physical structure and water holding capacity, resulting in more extensive root development and enhanced soil micro flora and fauna activity, all of which canaffect the levels of micronutrients available to plants (Zeidan, 2007).The best means of maintaining soil fertility and productivity could be through periodic addition of organic materials either alone or in addition to mineral fertilizers. However, Shafeek, *et al* (2003) reported that, the best plant growth parameters (length of plant, number of leaves and fresh and dry weight of whole plant and its different organs, all of them were associated with addition organic nitrogen at rate 60 kg N/ fed. also the heaviest bulbs yield and the gloves tissues content of minerals were correlated with organic manure addition.To promote plant growth with compost extract the extract must be derived from compost that also promotes plant growth (Shrestha *et al.*,2011).However, Abou El-Magd *et al.,* (2012) reported that vegetative growth parameters, plant length, leaf number and fresh and dry weight of leaves as well as total yield and its quality (bulb weight and marketable yield) of garlic plants were used to evaluate the various organic material. Other authors added that, organic manures fertilizers are slow release forms of nitrogen where natural organic materials are broken down slowly by the soil microorganisms (Shafeek *et al* 2003). In the same respect, Hassan (2015) found that compost manure treatment recorded the highest values of the plant height, number of leaves per plant and fresh as well as dry weight of whole plant, chemical composition and yield of garlic plants. Also the high maximum bulb weight clove weight and total fresh yield, it could be recommended to use compost manure at high level. Many investigators studied the effect of organic fertilization on growth of garlic plant (Stewart *et al.,* 2005, Gaviola and Lipinski, 2008, El-Hifny, 2010, Ahmed *et al.,* 2012,Nori *et al.*,2012, Diriba-Shiferaw, 2014 and Zaki *et al.,* 2014).

Humic acid is a product contains many elements which improve the soil fertility and increase the availability of nutrient elements by holding them on mineral surfaces and consequently affect plant growth and yield (Akinci *et al* 2009). Humic substances are the subjects of studies in various areas of agriculture such as soil chemistry, fertility, plant physiology and environmental sciences as the multiple roles played by these materials can greatly improve plant growth and nutrient uptake (Paksoy *et al* 2010). Although seed treatment and foliar application of Humic substances is increasingly used in agricultural practice, the mechanism of possible growth promoting effect, usually attributed to hormone-like impact, activation of photosynthesis and improved nutrient uptake (Chen and Aviad, 1990; Fernandez *et al.,* 1996; Kulikova *et al.,* 2005 and Verlinden *et al* 2009), remains unclear. However, AbdEl-Al *et al* (2005)

reported that foliar application of humic acid at different levels had a significantly effect on growth characters and total yield and its components as well as chemical characters all of them resulted its highest values only with that onion plants which sprayed with humic acid at 6 L\fed. but that onion plants which sprayed with humic acid at level of 12 L\fed. resulted less plant growth as well as yield and its components in addition caused an increment in TSS, N,P,K, Fe, Mn, and Zn in bulb tissues. Improved growth, yield production, quality and significant increase in the accumulation of P, K, Ca, Mg, Fe, Zn and Mn in tissues of onion bulb as well as increased accumulation of N, Ca, Fe, Zn and in roots (Erik *et al* 2000). Moreover, El-Shabrawy *et al* (2010) found that soil application of humic acid at 0.5 % had significant effect on nitrogen, phosphorus and potassium. Many investigators reported that application of humic substances led to a remarkable increment in soil organic matter which improves plant growth and increases crop production (AbdEl-Aal *et al* 2005, Shafeek *et al* 2013, Shafeek*et al* 2014 and Aisha *et al* 2014).

The aim of this work was to study the effect of different levels of organic manure fertilizer and humic acid at different levels on growth, total bulb yield and its components as well as the contents of garlic cloves on nutritional values.

Materials and Methods

Two field experiments were carried out at the experimental station of National Research Centre at Nubaria, Behira Governorate, Egypt during the two growing seasons of 2013 and 2014 in order to study the effect of the addition of different levels (40, 80 and 120 kg N/fed.) of organic manure (Nile compost) produced by recycling the agricultural residues with various concentrations of humic acid (0, 2 and 4 L /fed.) on vegetative growth, total bulbs yield and its components as well as bulb quality of garlic plants (*Allium sativum* L.) cv. Chinese. The physical and chemical properties of organic manure (Nile compost) are shown in table 1 and the chemical analysis of used humic acid are presented in table 2. The experimental site had a sandy soil texture with pH of 7.6, Ec of 0.19 and the organic matter was 0.21% with 14.00, 8.90 and 15.60 mg/100g soil of N, P and K respectively. Phosphorus (P_2O_5) and potassium (K_2O) were applied 50 and 100 kg/fed. each at the time of soil preparation.

The experimental design used in the two growing seasons was split plot with three replicates the three levels of organic manures (40, 80 and 120 kg N/fed.) were arranged at random in main plots while the three levels of humic acid (0, 2 and 4 L/fed.) were distributed within the subplots. Each plot area was 12.8 m^2consisted of four ridges; each was 0.8 m in width and 4 m in length. Whereas, the humic acid was mixed thoroughly with water and applied at three levels, i.e. 0, 2and 4 L/fed. and divided into three equal portions, first portion was added at 45 days from sowing and the secondwas added at 60 days and the third was added at 75 days from sowing. The normal agriculture practices of garlic under drip irrigation system were followed according to the recommendations of Agriculture Ministry. The levels for organic manure fertilizer was applied during soil preparation. But the chemical phosphorus and potassium fertilizer were added at rate of 200 and 150 kg/fed. as calcium super phosphate and potassium sulphate respectively. Phosphorus and potassium fertilizer were applied at once time during preparing the soil for planting. The Chinese cv. of garlic cloves was planted on the first week of October month in the seasons of

2013 and 2014. The gloves were sown at 20 cm distances on the two sides of each ridge. After 3 months from planting samples of garlic plants from the three replicates were taken and vegetative growth characters were measured (plant length, number of leaves, fresh and dry weight of whole plant and total chlorophyll content). At harvest after 5 months and after curing period (15 days) the total yield per feddan as ton were accounted also the average weight of bulbs, bulb diameter, number of cloves/ bulb and weight of clove was recorded. The percentage of nitrogen, phosphorus and potassium content in tissues of garlic cloves were determined depending on the methods which were described by Jackson (1958), Troug and Moyar (1939) and Brown and Lille land (1946) respectively. In addition, the protein percentages in tissues of garlic cloves were calculated by multiplying nitrogen content by 6.25.All data values were subjected to the analysis of variance to Gomez and Gomez (1984).

Results and Discussion

Growth characters

Effect of compost manure levels:

Data in table 3 show the linear relationship between nitrogen levels and garlic plant growth characters in two experiments of 2013 and 2014. Adding of compost manure at level of 80 kg N/fed. and 120 kg N/fed. for garlic plants resulted in the highest values of plant length, the biggest number of leaves, the heaviest fresh and dry weight of whole plant and total chlorophyll contents. These findings were true in both experimental seasons. However, as nitrogen level increased vegetative growth increased up to the highest nitrogen level, i.e.120 kg N/fed. With other words, that plants which supplied high level of compost manure (120 kgN/fed.) gave superiority in all plant growth characters over than the medium level (80 kg N/fed.). The results were nearly similar in the two seasons of the experiment. Some investigators showed the same trend (Shafeek *et al.,* 2003, Gaviola and Lipinski, 2008, El-Hifny,2010, Abou El-Magd *et al.*, 2012, Nori *et al.,* 2012, Patel and Patel *et al.,* 2012 and Diriba-Shiferaw, *et al* 2014). The increase of plant growth by increasing organic nitrogen level might be due to its role in photosynthesis, protein synthesis, cell division and enlargement which are the basal steps of plant growth. In addition, organic nitrogen plays an important role in the enzyme activity which reflectsmore products needed in plant growth.

Effect of humic acid levels:

Our results showed that application of Humic acid significantly influenced plant length, number of leaves /plant, fresh and dry weight of whole plant as well as total chlorophyll content of garlic plants (Table 3). However, by increasing rate of humic acid increased growth characters in both seasons. The statistical analysis also showed that the low and high levels of humic acid (2 or 4 L/fed.) significantly increased all growth characters compared to the control. In the same respect, the application of high level of humic acid (4 L/fed.) significantly increased all growth characters compared to the low level (2 L/fed.). The manifold significance of humic acid application to plants is now well established. Moreover,

MacCarthy *et al.* (2001) concluded that humates enhance nutrient uptake, improve soil structure, and increase the yield and quality of various crops. Humic acid was influence plant growth both in direct and indirect ways. Indirectly, it improves physical, chemical and biological conditions of soil. While directly, it increases

chlorophyll content, accelerates plant respiration and hormonal growth responses, increases penetration in plant membranes, etc. These effects of humic acid operate singly or in integration. The above discussion clearly validates the suitability of humic acid as a beneficial fertilizer product. Many investigators obtained data support the recent results (Erik *et al* 2000, AbdEl-Al *et al* 2005, El-Shabrawy *et al* 2010, Shafeek *et al* 2013 and 2014 and Aisha *et al* 2014).

Effect of the interaction between compost manure and humic acid levels

The interaction effect of adding organic compost manure with humic acid levels on the garlic plant growth characters table 3 recorded that all increasing the levels of organic compost manure and humic acid increased all plant growth characters compared to all concentrations treatments but these increased non significant in the two studied seasons except total chlorophyll content in garlic leaves produced significantly increases by the application of high level of compost manure (120 kg N/fed.) with high level of humic acid (4 L/fed.). On the contrary, the poorest garlic plant growth characters was associated with that plants received low level of compost manure (40 kg N/fed.) and without level of humic acid adding (control). These results were consequently similar in both experimental seasons.

Total bulb yield and its components:

Effect of compost manure levels:

Data in table 4 showed clearly that the addition of organic compost manure fertilizer which produced from recycling the agricultural residues caused an increase in total root yield (fresh and dry weight of bulb) of garlic plants and its physical properties (diameter, number of cloves/bulb and weight of cloves). Moreover, obtained data revealed that increasing the rate of organic compost manure up to (120 kg N/fed.) resulted in the highest total bulbs yield per fed. (4.83ton/fed.) in the first season and (4.77 ton/fed.) in the second season respectively). However, the obtained data reported that the medium addition of organic manure (80 kg N/fed.)and the high level (120 kg N/fed.) significantly increased total bulb yield and physical bulb quality compared low level (40 kg N/fed.). In other words, addition of (120 kg N/fed.) of organic compost manure fertilizer had superiority on fresh and dry weight of bulb as well as the physical bulb quality (diameter, number of cloves/bulb and weight of cloves). compared low level (40 kg N/fed.) in both seasons. It could be suggested that, the superiority of high level of organic compost manure these may be due to the effect of its manure was producing good growth of garlic plants (Table 3) which reflected on the bulb fresh and dry weight as well as the physical bulb quality. Similar results were obtained by Shafeek *et al* (2003), El-Shabrawy *et al* (2010), Shafeek *et al* (2013) and (2014), Aisha *et al* (2014) and Magda *et al* (2015).

Effect of humic acid levels:

Total garlic bulb yield as ton\fed. recorded its heaviest values (4.47 and 4.44 ton\fed. for 1st and 2nd seasons respectively with addition of humic acid at rate of 4L\fed. Table 4 shows clearly that the application of high level of humic acid (4L/fed.) had a significant effect on bulb fresh and dry weight as well as bulb quality (diameter, number of cloves/bulb and weight of cloves) in both two experimental seasons compared to low levels (2 L/fed.). Whereas, supplying garlic plants by humic acid at level of (2 L/fed.) resulted the heaviest fresh weight of

root compared control treatment. However, humic substances are mostly used to remove or decreased the negative effects of chemical fertilizers from the soil and have a major effect on bulb yield as shown by many scientists (Ghabbour and Davies, 2001). Also, humic acid stimulate plant growth by the assimilation of major and minor elements, enzyme activation and /or inhabitation, changes in membrane permeability, protein synthesis and finally the activation of biomass production (Ulukan, 2008). In this respect, AbdEl-Al *et al* (2005) reported that foliar application of humic acid at different levels had a significantly effect on growth characters and total yield and its components as well as chemical characters all of them resulted its highest values only with that onion plants which sprayed with humic acid at 6 L\fed. but that onion plants which sprayed with humic acid at level of 12 L\fed. resulted less plant growth as well as yield and its components in addition caused an increment in TSS, N,P,K, Fe, Mn, and Zn in bulb tissues. Furthermore, the promotion effect of humic acid on yield characters of garlic plants was due to its higher nutritional value in addition to its capacity to improve the hydro-physical properties of the soil. However, Sajid*et al* (2012) reported that the growth and yield parameter of onion plants were significantly influenced by various levels of humic acid.

Table.1 Physical and chemical properties of Nile compost

Character	Nile compost values
Weight of cubic meter (kg)	400
Moisture%	30
pH	7
Ec (m. mhos)	5
Organic carbon %	41
Organic matter %	70
Total nitrogen %	2
C/N ratio	1: 17
Total phosphorus %	0.6
Total potassium %	6.0
Iron mg/kg	7900
Manganese mg/kg	190
Copper mg/kg	20
Zinc mg/kg	4.75

Table.2 Humic acid total analysis

Guaranteed Analysis	
Humic acid	80%
Potassium (K2O)	10-12%
Zn, Fe, Mn, etc.	100 ppm
Physical Data	
Appearance	Black powder
pH	9-10
Water solubility	> 98 %

Table.3 Effect of fertilizers by compost manure and humic acid levels on growth characters of garlic plants during 2013 and 2014 seasons

Compost levels ton\fed.	Humic acid levels L\fed.	2013 season					2014 season				
		Plant length (cm)	Number of leaves\plant	Weight of plant (g)		Total chlorophyll	Plant length (cm)	Number of leaves\plant	Weight of plant (g)		Total chlorophyll
				fresh	dry			fresh	fresh	dry	
40	0	41.33	5.00	69.70	9.40	16.86	41.83	5.33	70.43	7.81	16.47
	2	43.67	5.33	77.45	9.45	23.03	43.03	6.33	74.30	8.58	19.73
	4	48.33	6.00	79.88	10.45	23.60	45.00	7.33	78.21	8.69	22.23
Mean		**44.44**	**5.44**	**75.68**	**9.77**	**21.17**	**43.29**	**6.33**	**74.31**	**8.36**	**19.48**
80	0	50.67	7.00	84.50	9.77	24.15	46.00	8.33	81.10	9.11	23.37
	2	56.33	7.33	85.00	10.70	26.04	52.00	8.67	84.60	9.41	24.40
	4	59.00	9.00	101.51	12.42	35.06	56.00	9.33	96.30	10.83	30.97
Mean		**55.33**	**7.78**	**90.34**	**10.96**	**28.42**	**51.33**	**8.78**	**87.13**	**9.78**	**26.24**
120	0	61.00	9.67	105.33	12.25	33.19	58.67	10.00	108.80	12.09	32.50
	2	62.33	10.00	111.67	13.27	38.33	61.47	10.67	119.87	13.62	36.20
	4	65.00	10.67	119.33	16.87	56.12	61.73	11.33	127.33	14.37	46.10
Mean		**62.78**	**10.11**	**112.11**	**14.13**	**42.55**	**60.62**	**10.67**	**118.67**	**13.36**	**38.27**
Average	0	51.00	7.22	86.51	10.47	24.73	48.83	7.89	86.78	9.67	24.11
	2	54.11	7.56	91.37	11.14	29.13	52.17	8.56	92.92	10.54	26.78
	4	57.44	8.56	100.24	13.24	38.26	54.24	9.33	100.61	11.29	33.10
LSD at 5% level	compost	**1.73**	**0.98**	**2.81**	**0.89**	**1.41**	**1.18**	**0.64**	**1.19**	**0.97**	**1.05**
	Humic	**1.75**	**0.71**	**2.54**	**0.68**	**2.18**	**1.15**	**0.53**	**3.20**	**0.88**	**0.81**
	interaction	**NS**	**NS**	**NS**	**NS**	**3.77**	**NS**	**NS**	**NS**	**NS**	**1.40**

Table.4 Effect of fertilizers by compost manure and humic acid levels on total yield and its components of garlic plants during 2013 and 2014 seasons

Compost levels ton\fed.	Humic acid levels L\fed.	2013 season						2014 season					
		Total yield (ton\fed.)	Weight of bulb (g)		Bulb diameter (cm)	N. of cloves\bulb	Weight of clove (g)	Total yield (ton\fed.)	Weight of bulb (g)		Bulb diameter (cm)	N. of cloves\bulb	Weight of clove (g)
			fresh	dry					fresh	dry			
40	0	3.45	26.06	15.52	2.50	8.00	1.98	3.49	23.53	14.96	2.20	8.33	1.77
	2	3.61	29.15	17.03	2.67	10.33	2.52	3.80	28.00	15.58	2.40	9.00	2.27
	4	3.78	31.93	18.30	2.73	11.33	2.74	3.99	31.63	16.57	2.47	10.00	2.77
Mean		**3.61**	**29.04**	**16.95**	**2.63**	**9.89**	**2.42**	**3.76**	**27.72**	**15.71**	**2.36**	**9.11**	**2.27**
80	0	4.02	33.29	18.87	2.83	12.33	2.68	4.13	33.40	17.84	2.70	13.00	2.87
	2	4.32	36.55	18.77	2.95	13.33	3.06	4.24	36.20	18.20	2.90	14.00	3.70
	4	4.62	38.39	19.54	3.38	14.67	3.73	4.40	39.44	19.74	3.07	16.33	3.95
Mean		**4.32**	**36.08**	**19.06**	**3.05**	**13.44**	**3.16**	**4.26**	**36.35**	**18.59**	**2.89**	**14.44**	**3.51**
120	0	4.70	40.37	20.03	4.02	13.00	4.32	4.56	41.33	20.97	3.72	13.00	4.15
	2	4.81	42.45	22.18	4.84	12.33	4.86	4.81	43.13	21.93	3.95	11.67	4.88
	4	5.00	49.26	23.64	4.95	11.00	6.06	4.93	45.67	24.46	5.20	11.00	5.67
Mean		**4.83**	**44.03**	**21.95**	**4.60**	**12.11**	**5.08**	**4.77**	**43.38**	**22.46**	**4.29**	**11.89**	**4.90**
Average	0	4.06	33.24	18.14	3.12	11.11	2.99	4.06	32.76	17.93	2.87	11.44	2.93
	2	4.2	36.05	19.33	3.49	12.00	3.48	4.29	35.78	18.57	3.08	11.56	3.62
	4	4.47	39.89	20.49	3.69	12.33	4.18	4.44	38.91	20.26	3.58	12.44	4.13
LSD at 5% level	compost	**o.o3**	**0.98**	**1.38**	**0.43**	**1.42**	**0.41**	**0.18**	**3.51**	**1.09**	**0.28**	**0.64**	**0.41**
	Humic	**0.03**	**1.75**	**NS**	**NS**	**NS**	**0.33**	**0.14**	**1.32**	**1.19**	**0.32**	**NS**	**0.27**
	interaction	**0.05**	**NS**	**NS**	**NS**	**1.70**	**NS**	**NS**	**NS**	**NS**	**NS**	**1.36**	**NS**

Table.5 Effect of fertilizers by compost manure and humic acid levels on chemical content of garlic bulb tissues during 2013 and 2014 seasons

Compost levels ton\fed.	Humic acid levels L\fed.	2013 season				2014 season			
		%				%			
		N	Protein	P	K	N	Protein	P	K
40	0	0.51	3.17	0.19	0.73	0.54	3.38	0.18	0.71
	2	0.59	3.67	0.20	0.74	0.60	3.73	0.20	0.74
	4	0.63	3.94	0.21	0.76	0.64	4.02	0.22	0.75
Mean		**0.57**	**3.59**	**0.20**	**0.74**	**0.59**	**3.71**	**0.20**	**0.73**
80	0	0.69	4.31	0.23	0.77	0.66	4.14	0.24	0.78
	2	0.75	4.67	0.25	0.77	0.68	4.25	0.25	0.83
	4	0.78	4.85	0.28	0.83	0.75	4.69	0.27	0.86
Mean		**0.74**	**4.61**	**0.25**	**0.79**	**0.70**	**4.36**	**0.25**	**0.82**
120	0	0.83	5.17	0.30	0.87	0.79	4.96	0.29	0.87
	2	0.88	5.50	0.34	0.89	0.86	5.38	0.33	0.91
	4	0.91	5.69	0.35	0.90	0.93	5.81	0.36	0.93
Mean		**0.87**	**5.45**	**0.33**	**0.89**	**0.86**	**5.38**	**0.33**	**0.90**
Average	0	0.67	4.22	0.24	0.79	0.67	4.16	0.24	0.79
	2	0.74	4.61	0.26	0.80	0.71	4.45	0.26	0.83
	4	0.77	4.83	0.28	0.83	0.77	4.84	0.28	0.85
LSD at 5% level	compost	**0.02**	**0.11**	**0.02**	**0.04**	**0.02**	**0.13**	**0.02**	**0.01**
	Humic	**0.02**	**0.11**	**0.01**	**0.01**	**0.02**	**0.14**	**0.01**	**0.01**
	interaction	**NS**	**NS**	**0.01**	**0.01**	**NS**	**NS**	**NS**	**NS**

Effect of the interaction between compost manure and humic acid levels

The interaction treatments of organic manure and humic acid at different levels did not significantly affect on bulb fresh and dry weight as well as bulb diameter and weight of cloves in both seasons (Table 4). However, number of cloves/ bulb significantly increased by added the high level of compost manure with high level of humic acid.These finding were true in both seasons.

Chemical content of cloves tissues

Effect of compost manure levels

Results recorded in table 5 indicate that total nitrogen, protein, phosphorus and potassium percentages in garliccloves were statistically increased by increasing nitrogen level up to 120 kg N/fed., during both seasons ofstudy. In this respect, garlic plants fertilized with organic nitrogen manure fertilizers reflected the highest values of nitrogen, protein, phosphorus and potassium percentageduring both seasons of growth. Obtained results as in agreement with those reported by Shafeek *et al* (2003), Suthar (2009), Yassenand Khalid (2009), Aly (2010) and Dawood *et al*. (2011).

Effect of humic acid levels

The application of humic acid had a great effect on the value of some nutritional elements of garlic cloves tissues in the two studies seasons. Whereas, increased rates of the application of humic acid caused an increment in the percentage of N,protein, P and K, contents. However, using humic acid at rate of high level (4 L/fed.) resulted the highest values of the percentage of protein, N, P, and K in both seasons compared to medium (2L /fed.) and without (control).

Effect of the interaction between compost manure and humic acid levels

The interaction treatments between using the different organic manure fertilizer and humic acid levels on the chemical content of garlic cloves tissue are shown in table 5. The recorded data shows that, in spite of the no significant response of the percentage of N and Protein content in both seasons and the percentage of P and K contents in 2nd season only. But as a general, the addition of high level of compost manure (120 kg N\fed.) and the high level of humic acid (4L\fed.)had the heaviest and highest the percentage of N, Protein, P and K contents in the tissues of garlic cloves.

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