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RESPONSE OF GARLIC PLANTS TO THE EFFECT OF NITROGEN LEVELS AND SOME GROWTH STIMULANTS.

BY

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ABSTRACT

Two field experiments were conducted at the Agricultural Research Station (Kaha), Qalyoobia Governorate Egypt., during the two winter seasons of 2007/2008 and 2008/2009 to study the effect of nitrogen levels and spraying with different growth stimulants on growth, yield and chemical composition of garlic (*Allium sativum* L.) cv. Seds 40. The obtained results show that increasing the nitrogen fertilizer level from 60 up to 120 kg-N/fed. significantly increased all the studied growth traits i.e., plant height, number of leaves fresh and dry matter of leaves but such increments did not reach the level of significancy in case of dry matter percentage during the first season and number of leaves/plant during the second one. Obtained data indicate also, that spraying the plants with Peptone at 0.5 g/L. exhibited the highest value in all measured growth aspects followed by using Hammar at 0.25 g/L compared with Mega power at (1.5 cm/L.) and the control treatment. Application of 120 kg-N/fed. combined with spraying the plants with either Peptone at 0.5 g/L. or Hammer at 0.25 g/L. reflected the highest values for growth rate during both seasons of study. All the studied bulb parameter were not significantly affected due to the increasing nitrogen level from 60 up to 120 kg-N/fed. during both seasons of study. Meanwhile foliar spray of Peptone at 0.5/L. reflected the highest values in this concern. Application of 90 or 120 kg-N/fed. combined with spraying the plants with Peptone at 0.5 g/L. three times during the growing season reflected the highest values of average clove weight, fresh and dry matter percentage for produced bulbs as well as total produced yield per feddan. Application of 120 kg-N/fed. recorded the highest values of chemical composition of garlic bulbs, during the both seasons of this study . Spraying garlic plants with Hammar at 0.25 g/L increased phosphorus concentration during both seasons of study compared with the control and other tested growth stimulants. Application of high level of nitrogen (120 kg-N/fed.) combined with spraying plants with either Hammar or Peptone reflected the highest concentration in all determined chemical constituents in garlic bulbs (total nitrogen, phosphorus, protein and nitrate-N).

INTRODUCTION

Garlic (*Allium sativum* L.) is one of the most important crops for local consumption and exportation. Nitrogen fertilization greatly affected garlic plants growth, bulb yield and its quality (Setty *et al.*, 1989, Kaker *et al.*, 2002 and Kilgori *et al.*, 2007 on garlic, El-Desuki, 2004 and Nasreen *et al.*, 2007 on onion and Avdienco *et al.*, 2003, Murashev 2003 and Zidan and Daiob 2005 on potato).

Humic acid a commercial product that contains many elements which improve the soil fertility and increase the availability of nutrient elements and consequently increase plant growth and yield (Chen and Aviad, 1990, David *et al.*, 1994, Tugarinof 2002, Koznitsov 2003, Abdel-Mawgoud *et al.* (2007) and Yildirim, 2007 on tomato; Hartwigson and Evans, 2000 and Havez, and Magda 2003 on

squash; Erik *et al.* (2000), El-Desuki (2004) on onion. Zidan and Daiob 2005 on potato El-Ghozoli, 2003 and El-Ghamry *et al.*, 2009 on faba bean)..

Humates and alpha - keto amino acids are two other bio stimulants that are currently being marketed to vegetable crops growers. Humates are derived from oxidized coal or decaying plant matter and are salts of humic acid (Bryan, 1976). Humic substances appear to be beneficial in that they may chelate nutrients, preventing their tie up on plant leaves and improving conductivity of nutrients into plant tissues, resulting in more efficient utilization of nutrients (Beames, 1986). Regarding the effect of humates on chemical composition, many investigators found that, humic acid increased plant dry matter and nutrient uptake (David *et al.*, 1994, and El-Desuki, 2004) and cell permeability (Gumminski *et al.*, 1983), as well as decreased nitrate accumulation in onion bulbs (El-Desuki, 2004).

This study was initiated to investigate the effect of nitrogen fertilization and use of some commercial compounds that stimulate growth, so the possibility to reduce the use of nitrogen by using some such growth stimulants that are considered as safe sources of nitrogen and other nutrients to improve growth and produce high yield with best quality of garlic.

MATERIALS AND METHODS

A field experiment was conducted at the Agricultural Research Station (Kaha), Qalyoubia Governorate. Egypt, during the two winter seasons of 2007/2008 and 2008/2009 to study the effect of nitrogen levels and spraying with different growth stimulants on growth, yield and chemical composition of garlic (*Allium sativum* L.) cv. Seds 40. This study including two factors and twelve treatments, which were as follows:

- Nitrogen fertilization levels: 60, 90 and 120 kg N/feddan.
- Growth stimulants: Hammar at (0.25 g/liter), Peptone at (0.5 g/liter) and Mega power at 1.5 cm/L. in addition to the control (tap water). Garlic seed (cloves) were planted on October 10^{th} and 7^{th} during the first and second seasons, respectively. The experimental plot area was 8.64 m^2 and included three rows; each was 320 cm length and 90 cm width. The distance between plants was 7 cm. The treatments were arranged in split plot design with three replicates. The nitrogen fertilization levels were distributed in the main plot whereas, growth stimulants treatments were occupied the sub plot. Nitrogen fertilization was added in the form of ammonium sulphate (20.6 % N) and the amount of fertilizer was divided into three equal portions. The first portion was added two months after planting, while the second and third portions of fertilizer were added at three and four months after planting, respectively.
- Growth stimulants were sprayed three times the first was two month after planting while, second and third sprays were done after three and six weeks after the first one .

The soil of the experimental field was clay loam in texture. The physical and chemical properties of soil were shown in Table (1).

Data recorded:

A-Vegetative growth characters.

Ten plants were randomly chosen after 18 weeks from planting from each subplot for determination of vegetative growth characteristics as follows:

- Plant length (cm). It was measured from base of swelling sheath to the tip of the largest linear blade in plant.
- Number of leaves per plant. Number of leaves calculated as the average number of green leaves per plant.
- Leaves fresh weight (g). It was determined as average weight of plant after the removal of bulbs at neck zone.
- Dry matter (%).A representative sample of 100 g from fresh weight of each of different plant parts were taken and dried in an electric oven to constant weight at 70 C° and dry weight percentage of each of plant foliage and bulbs were calculated.

Table (1): The physical and chemical properties of the experimental soil:

Variable	2007/2008	2008/2009
1- Physical properties		
Clay %	60.70	60.40
Silt %	21.10	22.00
Sand %	18.20	17.60
Texture	**Clay loam**	**Clay loam**
2- Chemical properties		
Available		
N (ppm)	98.9	99.6
P(ppm)	5.9	4.66
K (ppm)	216.2	215.6
pH	7.4	7.6

The chemical composition of the used growth stimulants were as shown in Table (2).

Table (2): Chemical properties of growth stimulants.

Variable	Chemical properties
Hammar	Humic acid 86 % Potassium oxide 6 % Fulvic acid 7 %
Peptone 16/85	Total amino acids 86 % Free –L amino acids 16 % Organic N 12 % $K_2O_{2.}$ 5 %
Mega power-x	Humic acid 19 % Fulvic acid 2.0 % Free amino acids 5% Chelate Zn 0.5% Chelate Mn 0.05 % Chelate Fe 0.025 % potassium citrate 2 %

B- Yield and its components.

With respect to yield and its components, bulb properties and chemical composition, sample were taken at harvest (26 weeks after planting) to record the following characteristics:

- Average bulb weight (g). It was determined as an average weight of ten plants after the removal of the foliage at neck zone.
- Total yield (ton/fed.). At harvest (180 days from planting), plants of each experimental plot were harvested, weighted and total yield of whole plants (ton/fed.) was calculated.
- Average bulb length and diameter (cm). Bioclase was used to measure bulb length and diameters.
- Average neck diameter (cm). Bioclase was used to measure neck diameters.
- Bulb dry matter (%). It was as the in aforementioned in the leaves.

C- Chemical constituents.

In the digested, dry matter of bulbs, total nitrogen was determined according to the method described by Pregl (1945) using micro-kjeldahl apparatus. Meanwhile, phosphorus was estimated calorimetrically according to the method described by Murphy and Riley (1962) as modified by John (1970). Furthermore, nitrate content was estimated according to salicylic acid method for nitrate determination (Cataldo *et al.*, 1975). Protein percentage was determined as nitrogen content and converted to its equivalent protein content by multiplying by 6.25.

D-Statistical analysis: -

All obtained data were subjected to statistical analysis according to Gomes and Gomes (1984).

RESULTES AND DISCUSSION

1-Vegetative growth characteristics.

Data recorded in Table (3) show the effect of nitrogen fertilization levels and growth stimulants as well as their interaction on vegetative growth aspects for garlic plants expressed as plant length, number of leaves and fresh weight as well as dry matter percentage per plant during both seasons of study.

a-Effect of nitrogen fertilization.

Data in Table (3) indicate that there were significant differences in most studied growth parameters among the used levels of nitrogen fertilizers during both seasons of growth. In this respect, increasing the nitrogen fertilizer level from 60 up to 120 kg-N/fed. increased all the studied growth traits (plant length, number of leaves and fresh weight per plant as well as dry matter percentage) but such increments did not reach the level of significancy in case of dry matter percentage during the first season and number of leaves/ plant during the second one. In this regard, such increasing in morphological parameters of garlic plants as a result of increasing the level of nitrogen application may be attributed to the main role of nitrogen in increasing the merstematic activity, cell division and cell elongation as well as formation of protoplasmic bulk which consequently affected growth of plants. Obtained results are in agreement with those recorded by Kaker *et al.*, (2002), Setty *et al.* (1989) and Kilgori *et al.*, (2007) on garlic and El-Desuki (2004) and Nasreen *et al.*, (2007) on onion who reported that nitrogen fertilization greatly affect garlic and onion plants growth.

b- Effect of growth stimulants.

Data in the same Table show clearly that plant length, number of leaves and fresh weight per plant as well as dry matter percentage were significantly affected as a result of spraying the plants with the tested growth stimulants i.e., Hammar, Peptone and Mega power three times during the growing season compared with the control treatment. In this concern, spraying the plants with Peptone at 0.5 g/L. exhibited the highest value in all measured growth aspects followed by using Hammar at 0.25 g/L compared with Mega power at (1.5 cm/L.) and the control treatment. Such results are the same during both seasons of study. Such increments in morphological parameters of garlic plants due to the application of both Peptone and Hammar may be due to the high content of amino acids and nitrogen in case of Peptone which affect directly protein and protoplasm formation which are required for cell, tissues and organs formation and the main role of Hammar on increasing the acidity of soil as results of higher content of humic and Fulvic acid which consequently increased the availability and uptake of nutrient ele-ments by plants which affect on plant growth. Obtained results are in conformity with those recorded by Chen and Aviad (1990), David *et al.*, (1994) and Yildirim (2007) on tomato, Hartwigson and Evans (2000) and Haves (2003) on squash and Erik *et al.*, (2000) and El-Desuki (2004) on onion. In this concern, Avdienco *et al.*, (2003), Murashev (2003) and Zidan and Daiob (2005) on potato reported that foliar spray of Bouldozer and Amion-rivald compounds on plants of potato enhanced vegetative growth characteristic i.e., plant length number of stems /plant fresh and dry weight of total plant foliage. El-Ghozoli (2003) and El-Ghamry *et al.*, (2009) found similar results on faba bean.

c- Effect of the interaction.

As for the effect of the interaction, the same data in Table (3) reveal that application of 120 kg-N/fed. combined with spraying the plants three times during the growing seasons with either Peptone at 0.5 g/L. or Hammar at 0.25 g/L. reflected the highest values for growth characters during both seasons of study.

2- Bulb characters.

Data presented in Table (4) show the effect of nitrogen fertilization and growth stimulants on bulb traits i.e., average bulb diameter, length, and number of cloves per bulb as well as neck diameter.

Table (3): Effect of nitrogen levels, some growth stimulants and their interaction on vegetative growth characteristics of garlic.

N levels (kg/Fed.)	Growth stimulants	2007/2008				2008/2009			
		Plant length (cm)	Leaves			Plant length (cm)	Leaves		
			No.	F.W (g)	D.M (%)		No.	F.W (g)	D.M (%)
60		71.41^{B}	9.03^{B}	76.33^{C}	15.64^{A}	7·.10^{C}	9.21^{A}	79.21^{B}	15.12^{B}
90		72.71^{B}	9.42^{AB}	79.49^{B}	15.77^{A}	71,87^{B}	9.39^{A}	83.02^{A}	15.39^{AB}
120		74.83^{A}	9.86^{A}	84.17^{A}	16.01^{A}	72.69^{A}	9.71^{A}	82.50^{A}	15.61^{A}
	Control	67.83^{C}	8.93^{C}	70.05^{D}	14.78^{B}	66.34^{D}	9.02^{B}	72.86^{D}	14.84^{C}
	Hammar	75.61^{A}	9.61^{AB}	82.59^{B}	16.15^{A}	73.01^{B}	9.49^{AB}	83.33^{B}	15.20^{B}
	Peptone	76.66^{A}	10.03^{A}	88.67^{A}	16.45^{A}	74.93^{A}	9.94^{A}	89.96^{A}	16.17^{A}
	Mega power	71.83^{B}	9.17^{BC}	78.68^{C}	15.83^{A}	71.92^{C}	9.29^{AB}	80.13^{C}	15.29^{B}
60	Control	65.66^{E}	8.63^{C}	68.33^{G}	14.50^{C}	64.70^{I}	8.75^{B}	67.03^{G}	14.61^{F}
	Hammar	74.67^{B}	9.00^{BC}	77.57^{E}	15.93^{ABC}	71.46^{EF}	9.27^{AB}	81.67^{CD}	15.00^{DEF}
	Peptone	75.66^{AB}	9.93^{AB}	83.33^{C}	16.13^{AB}	74.00^{BC}	9.70^{AB}	89.30^{A}	15.83^{BC}
	Mega power	69.64^{CD}	8.55^{C}	77.10^{E}	15.98^{ABC}	70.22^{F}	9.11^{AB}	78.83^{E}	15.04^{DEF}
90	Control	67.50^{DE}	8.67^{C}	0.33^{FG}	14.98^{ABC}	66.33^{H}	8.90^{B}	79.67^{DE}	14.85^{EF}
	Hammar	75.67^{AB}	9.89^{AB}	80.67^{D}	15.98^{ABC}	73.60^{CD}	9.57^{AB}	83.00^{BC}	15.20^{DEF}
	Peptone	76.33^{AB}	10.00^{A}	89.00^{B}	16.50^{AB}	75.33^{AB}	9.93^{AB}	89.32^{A}	16.21^{AB}
	Mega power	71.36^{C}	9.11^{BC}	77.95^{E}	15.60^{ABC}	72.21^{DE}	9.17^{AB}	80.07^{DE}	15.29^{CDE}
120	Control	70.33^{C}	9.48^{ABC}	71.50^{F}	14.86^{BC}	68.00^{G}	9.40^{AB}	71.88^{F}	15.05^{DEF}
	Hammar	76.50^{AB}	9.93^{AB}	89.52^{B}	16.55^{A}	73.96^{C}	9.63^{AB}	85.33^{B}	15.40^{CDE}
	Peptone	78.00^{A}	10.17^{A}	93.67^{A}	16.73^{A}	75.46^{A}	10.20^{A}	91.27^{A}	16.47^{A}
	Mega power	74.50^{B}	9.86^{AB}	82.00^{CD}	15.91^{ABC}	73.33^{CD}	9.60^{AB}	81.50^{CDE}	15.53^{CD}

Table (4): Effect of nitrogen levels, some growth stimulants and their interaction on some bulb characters of garlic.

N. levels (kg/Fed.)	Growth stimulants	2007/2008				2008/2009			
		Neck dia-meter (cm)	Bulb		No. of cloves /bulb	Neck dia-meter (cm)	Bulb		No. of cloves /bulb
			Dia-meter (cm)	Length (cm)			Dia-meter (cm)	Length (cm)	
60		1.16^{A}	5.10^{A}	4.25^{A}	12.23^{B}	1.17^{A}	5.13^{A}	4.14^{A}	12.21^{A}
90		1.19^{A}	5.24^{A}	4.41^{A}	13.07^{A}	1.19^{A}	5.21^{A}	4.27^{A}	12.53^{A}
120		1.25^{A}	5.47^{A}	4.55^{A}	13.30^{A}	1.22^{A}	5.32^{A}	4.40^{A}	13.50^{A}
	Control	1.21^{A}	5.10^{B}	3.93^{B}	12.10^{B}	1.21^{A}	4.88^{B}	3.96^{A}	12.10^{C}
	Hammar	1.18^{A}	5.30^{AB}	4.55^{AB}	12.73^{B}	1.19^{A}	5.16^{B}	4.44^{A}	13.00^{AB}
	Peptone	1.18^{A}	5.60^{A}	4.93^{A}	13.82^{A}	1.16^{A}	5.80^{A}	4.62^{A}	13.43^{A}
	Mega power	1.22^{A}	5.19^{AB}	4.19^{AB}	12.81^{B}	1.20^{A}	5.05^{B}	4.06^{A}	12.45^{BC}
60	Control	1.18^{A}	4.93^{A}	3.76^{A}	11.9^{E}	1.19^{A}	4.80^{D}	3.87^{A}	11.10^{C}
	Hammar	1.17^{A}	5.13^{A}	4.43^{A}	12.3^{CDE}	1.16^{A}	5.03^{D}	4.25^{A}	12.60^{ABC}
	Peptone	1.14^{A}	5.35^{A}	4.73^{A}	12.7^{CDE}	1.15^{A}	5.70^{ABC}	4.52^{A}	13.00^{AB}
	Mega power	1.14^{A}	4.97^{A}	4.06^{A}	12.1^{DE}	1.17^{A}	4.98^{D}	3.92^{A}	12.15^{ABC}
90	Control	1.19^{A}	4.97^{A}	3.98^{A}	12.1^{DE}	1.22^{A}	4.87^{D}	3.90^{A}	11.50^{BC}
	Hammar	1.18^{A}	5.23^{A}	4.57^{A}	12.4^{CDE}	1.19^{A}	5.17^{CD}	4.48^{A}	12.70^{ABC}
	Peptone	1.18^{A}	5.54^{A}	4.96^{A}	14.67^{A}	1.16^{A}	5.83^{AB}	4.63^{A}	13.40^{A}
	Mega power	1.19^{A}	5.23^{A}	4.12^{A}	13.09^{DCE}	1.2·^{A}	4.97^{D}	4.06^{A}	12.50^{ABC}
120	Control	1.25^{A}	5.09^{A}	4.05^{A}	12.30^{DE}	1.23^{A}	4.97^{D}	4.11^{A}	13.70^{A}
	Hammar	1.20^{A}	5.53^{A}	4.65^{A}	13.50^{ABC}	1.22^{A}	5.27^{BCD}	4.58^{A}	13.70^{A}
	Peptone	1.23^{A}	5.90^{A}	5.09^{A}	14.10^{AB}	1.18^{A}	5.86^{A}	4.70^{A}	13.90^{A}
	Mega power	1.30^{A}	5.37^{A}	4.40^{A}	13.30^{BCD}	1.23^{A}	5.18^{CD}	4.21^{A}	12.70^{ABC}

Effect of nitrogen fertilization.

Data in Table (4) indicate that irrespective of the number of cloves per bulb which was significantly affected during the first season only, all the studied bulb parameters were not significantly affected due to the increasing nitrogen level from 60 up to 120 kg-N/fed. during both seasons of study. In this respect, such parameter tended to be increased with nitrogen application especially the highest used levels. Such parameters which are genetically connected were not affected by nitrogen application. Contra results were recorded by Setty *et al.*, 1989, Kaker *et al.*, (2002) and Kilgori *et al.* (2007) on garlic who reported that number of cloves /bulb, bulb diameter and length were gradually increased with increasing nitrogen fertilization from 0 up to 120 kg N/ha.

a-Effect of the growth stimulants.

Data in Table (4) show that neck diameter, bulb length, diameter and number of cloves per bulb were positively affected due to the different tested growth stimulants during both seasons of study compared with the control treatment. In this regard, spraying garlic plant with Peptone at 0.5 g/L. three times during the growth season reflected the highest values in all measured bulb parameters. In addition, using Hammar at 0.25 g/L. ranks the second in this respect. Obtained results are similar during both seasons of study. Such increasing effect of growth stimulants (Peptone and Hammar) on bulb parameters are connected with their effect on increasing vegetative plant growth (Table 3) which in turne affect on produced bulbs. Such results were conformity with El-Desuki (2004).

b-Effect of the interaction.

As for the effect of the interaction the same data in Table (4) indicate that application of nitrogen fertilizer at the highest used level (120 Kg-N/fed.) combined with spraying the plant with Peptone 0.5 g/L. or Hammar at 0.25 g/L. exhibited the highest values in all measured bulb parameter during both seasons of study. However, there were no significant differences were not in studied parameters between the application of nitrogen fertilizer at 90 and 120 kg-N/fed. and spraying the plants with Peptone.

3- Yield and its components.

Data presented in Table (5) show the effect of nitrogen fertilization levels and growth stimulants as well as their interaction on total yield and its components expressed as average Clove weight, yield, bulb fresh weight and dry matter percentage of produced bulbs during the two seasons of study.

a- Effect of nitrogen fertilization.

Data in Table (5) show clearly that average clove weight, fresh weight of bulb, dry matter percentage of bulbs as well as total produced yield were positively increased with increasing nitrogen level from 60 up to 120 kg-N/feddan. In this respect, application of 120 kg-N/fed. reflected the highest values in all studied yield components during both seasons of growth. However, such increments did not reach the level of significancy in average clove weight only during the two seasons of study. Such increments in total produced yield as a result of application of the highest level of nitrogen may be due to the increase in average bulb parameters and number of cloves/bulb (Table, 4) and the effect of nitrogen on vegetative growth aspects (Table,3) which in turn affected the produced yield. Obtained results are similar to these reported by and Kilgori *et al.*, (2007) on garlic El-Desuki (2004) and Nasreen *et al.*, (2007) on onion.

b- Effect of growth stimulants.

Data in Table (5) indicate that total produced yield and its components i.e., average clove weight, fresh weight of bulb and dry matter percentage of bulb were significantly increased as a result of spraying the plants with tested growth stimulants compared with the control treatment. In this regard, the highest recorded values were obtained due to spraying the plant three times during the growing seasons with Peptone at a concentration of 0.5 g/L. Such increase in total yield and its constituents as a result of spraying the plants with growth stimulants are connected with increase in vegetative growth parameters and bulb characters (Tables 3 & 4) which

consequently affected total produced yield. Obtained results are similar to those recorded by Chen and Aviad (1990), David *et al.*, (1994) and Yildirim (2007) on tomato and Evans (2000), Havez (2003) on squash and Erik *et al.*, (2000) and El-Desuki (2004) on onion. In this regard, Zidan and Daiob (2005) on potato found that nutrition of the plants with Humate, Baldozer and Amionrivald substances improved the average weight of tuber as compared with the control, and enhanced the yield. El-Ghamry *et* al.(2009) pointed out the same results on faba bean.

Table (5): Effect of nitrogen levels, some growth stimulants and their interaction on some aspects of bulb yield and its components of garlic plants.

N. levels (kg/Fed.)	Growth stimulants	2007/2008				2008/2009			
		Clove weight (g)	Bulb F.W (g)	Bulb D.M (%)	Total yield ton/fed.	Clove weight (g)	Bulb F.W (g)	Bulb D.M (%)	Total yield ton/fed.
60		2.49^{A}	65.56^{C}	27.98^{A}	8.562^{B}	2.65^{A}	66.42^{C}	27.83^{B}	8.290^{B}
90		2.67^{A}	66.74^{B}	29.05^{A}	10.268^{A}	2.71^{A}	67.79^{B}	28.70^{A}	10.551^{A}
120		2.76^{A}	68.17^{A}	28.88^{A}	10.528^{A}	2.78^{A}	71.02^{A}	28.76^{A}	10.770^{A}
	Control	2.57^{A}	58.22^{D}	26.26^{B}	8.826^{D}	2.62^{A}	62.98^{D}	25.71^{D}	8.819^{C}
	Hammar	2.68^{A}	69.35^{B}	29.35^{A}	10.104^{B}	2.73^{A}	69.35^{B}	29.26^{B}	10.201^{AB}
	Peptone	2.80^{A}	72.68^{A}	29.91^{A}	10.796^{A}	2.81^{A}	73.00^{A}	30.77^{A}	10.536^{A}
	Mega power	2.49^{A}	67.05^{C}	29.03^{A}	9.417^{C}	2.69^{A}	68.28^{C}	27.97^{C}	9.924^{B}
60	Control	2.50^{A}	57.37^{G}	25.70^{D}	7.691^{G}	2.53^{A}	59.33^{G}	25.23^{F}	7.256^{G}
	Hammar	2.57^{A}	68.33^{DE}	28.97^{ABC}	8.936^{EF}	2.65^{A}	$68.30D^{E}$	28.27^{CD}	8.958^{E}
	Peptone	2.72^{A}	71.20^{BC}	29.25^{ABC}	9.194^{DEF}	2.80^{A}	70.70^{C}	25.80^{F}	8.173^{F}
	Mega power	2.17^{A}	65.33^{F}	28.00^{BC}	8.426^{FG}	2.64^{A}	67.33^{E}	27.63^{DE}	8.771^{EF}
90	Control	2.56^{A}	58.20^{G}	27.77^{C}	9.329^{DEF}	2.61^{A}	61.10^{F}	30.17^{AB}	9.495^{DE}
	Hammar	2.69^{A}	69.67^{CD}	28.97^{ABC}	10.645^{BC}	2.77^{A}	$69.09D^{E}$	29.60^{BC}	10.756^{B}
	Peptone	2.80^{A}	72.83^{AB}	30.01^{AB}	11.449^{AB}	2.75^{A}	73.10^{B}	31.23^{A}	11.693^{A}
	Mega power	2.62^{A}	66.28^{EF}	29.46^{AB}	9.648^{DE}	2.72^{A}	67.85^{E}	28.15^{CD}	10.259^{BC}
120	Control	2.65^{A}	59.10G	25.32^{D}	9.457^{DEF}	2.74^{A}	68.52^{DE}	26.10^{EF}	9.706^{CD}
	Hammar	2.79^{A}	70.04^{CD}	30.11^{AB}	10.732^{BC}	2.77^{A}	70.67^{C}	29.90^{AB}	10.889^{B}
	Peptone	2.89^{A}	74.00^{A}	30.47^{A}	11.746^{A}	2.87^{A}	75.20^{A}	30.90^{AB}	11.743^{A}
	Mega power	2.69^{A}	69.53^{CD}	29.63^{AB}	10.178^{CD}	2.72^{A}	69.67^{CD}	28.13^{CD}	10.743^{B}

c- Effect of the interaction.

As for the effect of the interaction the same data in Table (5) indicate that application of 90 or 120 kg-N/fed. combined with spraying the plants with Peptone at 0.5 g/L. three times during the growing season reflected the highest values of average clove weight, fresh and dry matter percentage for produced bulbs as well as total produced yield per feddan.

4-Chemical constituents of bulbs.

a- Effect of nitrogen fertilization.

Data recorded in Figs (1, 2, 3 and 4) show the effect of nitrogen fertilization on chemical constituents of produced bulbs expressed as total nitrogen, phosphorus, protein and nitrate-nitrogen content during both seasons of study. In this regard, the highest values in all assayed chemical constituents were observed as a result of the highest used level of nitrogen (120 kg-N/fed.) during both seasons of study. Such continuous increase in nitrogen level from 60 up to 120 kg-N/fed. were connected with the increasing the vegetative growth and in turne increased the uptake and concentration of such constituents. Obtained results are similar to those reported by (David *et al.*, 1994, and El-Desuki, 2004) and cell permeability (Guminski *et al.*, 1983), as well as decreased nitrate accumulation in onion bulbs (El-Desuki, 2004).

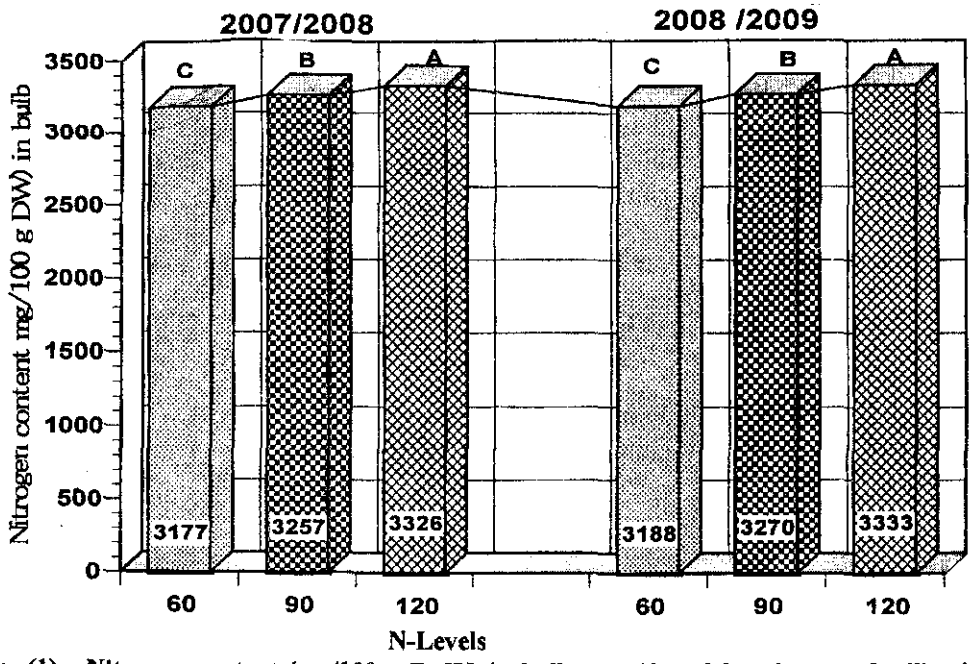

Fig. (1): Nitrogen content (mg/100 g D. W) in bulbs as affected by nitrogen fertilization during 2007/2008 and 2008/2009 seasons.

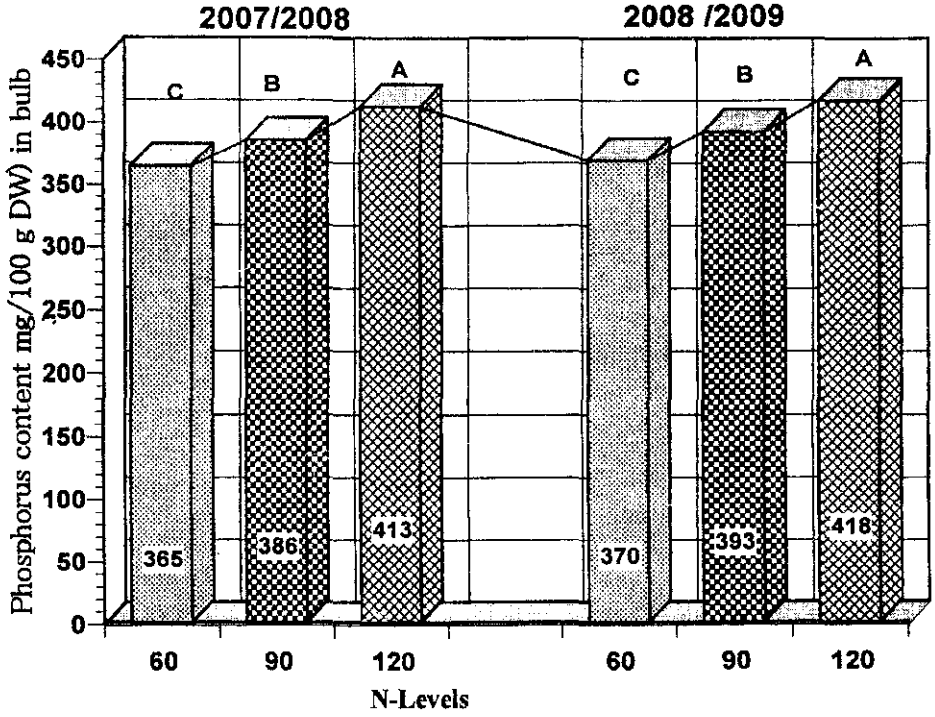

Fig. (2): Phosphorus content (mg/100 g D. W) in bulbs as affected by nitrogen fertilization during 2007/2008 and 2008/2009 seasons.

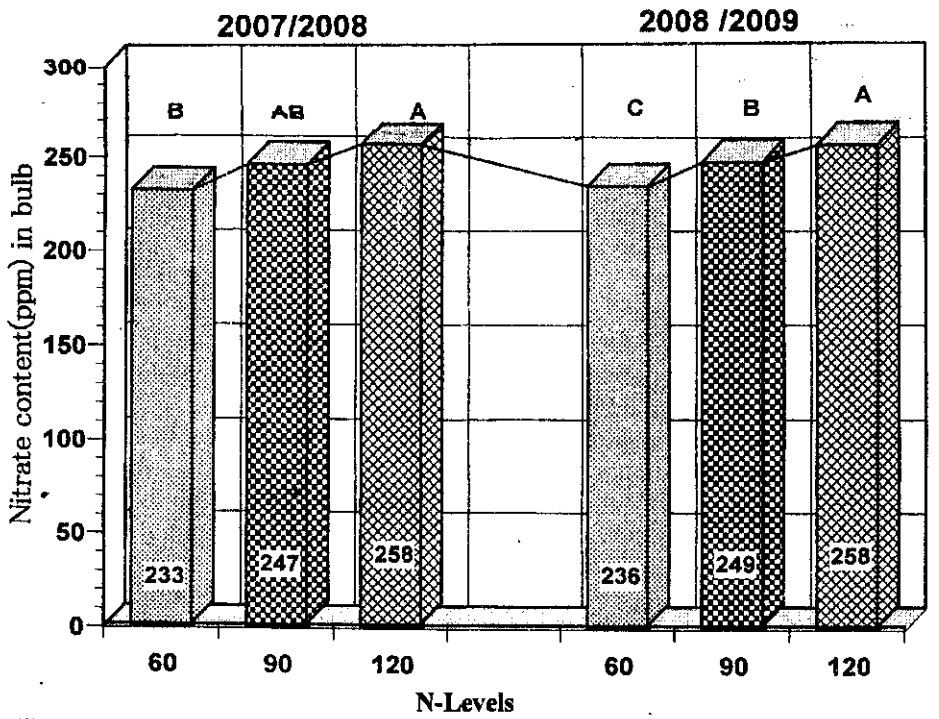

Fig. (3): Nitrate content (ppm) in bulbs as affected by nitrogen fertilization during 2007/2008 and 2008/2009 seasons.

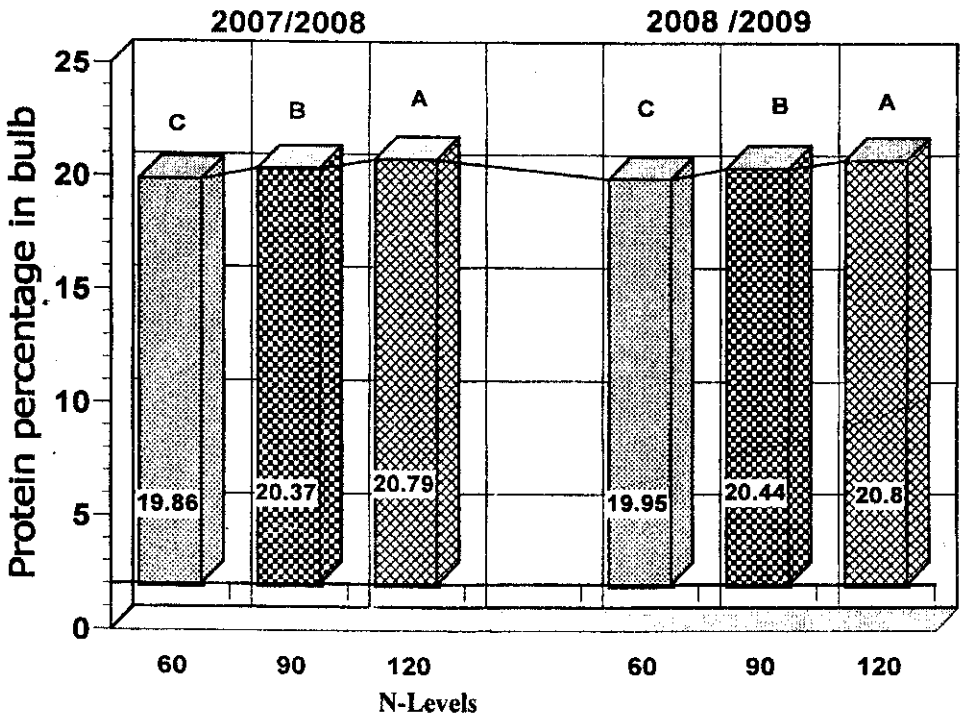

Fig. (4): Protein percentage in bulbs as affected by nitrogen fertilization during 2007/2008 and 2008/2009 seasons.

b-Effect of growth stimulants.

Data in Figs (5, 6, 7 and 8) indicate that spraying garlic plants three times during the growth season with Hammar at 0.25 g/L increased phosphorus concentration during both seasons of study compared with the control and other tested growth stimulants. However, it reduced nitrate-nitrogen accumulation during both seasons of study. Also such data show that no significant differences among the other studied growth stimulants (Peptone and Mega power) in nitrate content compared with the control treatment. However, application of Peptone at 0.5 g/L three times during the growing seasons reflected the highest value in protein concentration for the produced bulbs during both seasons of growth. In this respect, the highest content in phosphorus due to Hammar application may be due to the role of Hammar in reducing pH of the soil and consequently increased the availability of phosphorus in root zone and in turn increased the absorption in protein content due to Peptone application might be attributed to the amino acids content of Peptone which directly converted to protein by plant enzymes in plant cells.

Obtained results are similar to those reported by (Koznitsov 2003, Tugarinof 2002 on tomato, El-Ghozoli (2003) and El-Ghamry *et al.* (2009) on faba bean, and Zidan and Daiob (2005) on potato Moreover, Zidan and Daiob reported that Plants treated with humic and amino acids had lower content of dry substance and high content of nitrate as compared with control, whereas the opposite trend was found with humate treatment.

b- Effect of the interaction.

Data in Table (6) show clearly that application of high level of nitrogen (120 kg-N/fed.) combined with spraying plants with either Hammar or Peptone three times during the growing seasons reflected the highest concentration in all determined chemical constituents in garlic bulbs (total nitrogen, phosphorus, protein and nitrate-N). Such data are similar during both seasons of study.

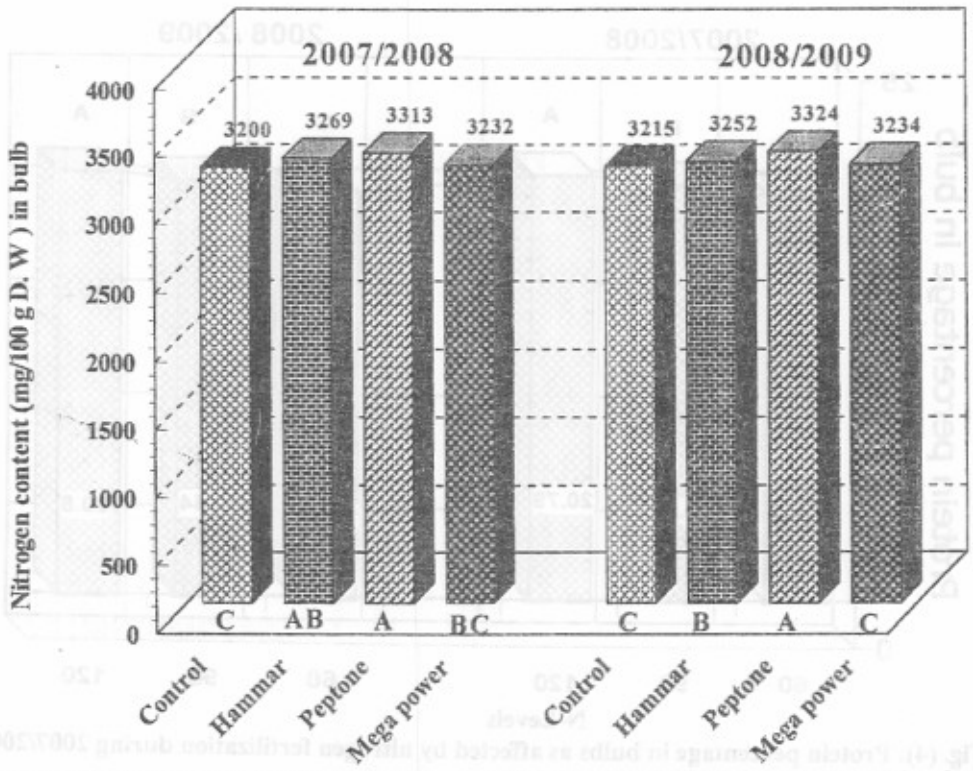

Fig. (5): Nitrogen content (mg/100 g D. W) in bulbs as affected by growth stimulants during 2007/2008 and 2008/2009 seasons.

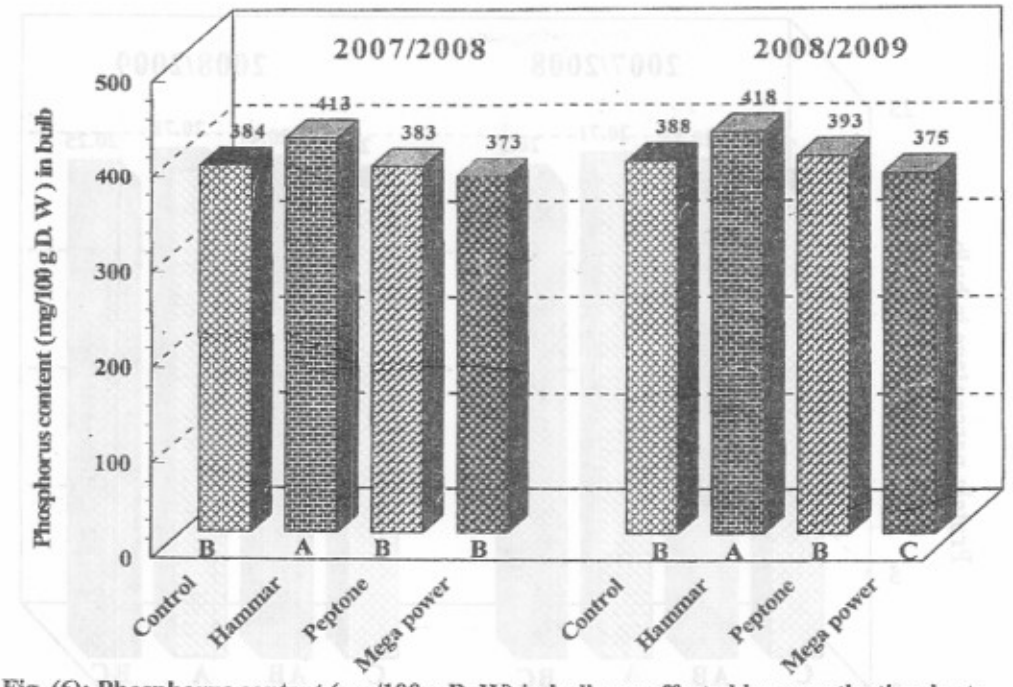

Fig. (6): Phosphorus content (mg/100 g D. W) in bulbs as affected by growth stimulants during 2007/2008 and 2008/2009 seasons.

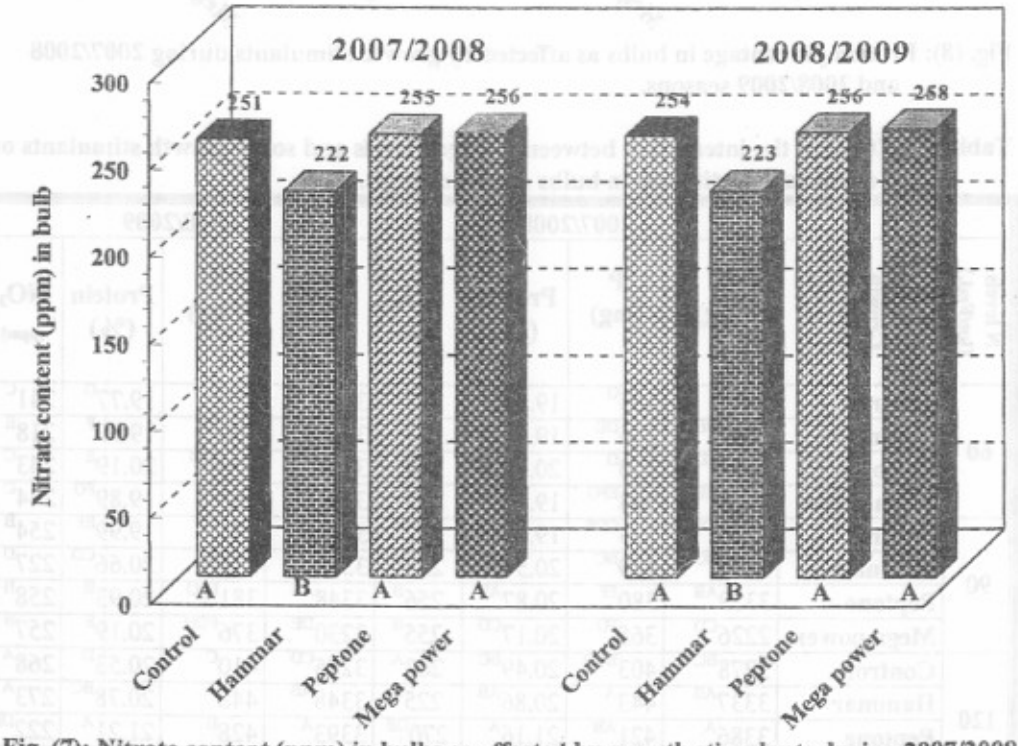

Fig. (7): Nitrate content (ppm) in bulbs as affected by growth stimulants during 2007/2008 and 2008/2009 seasons.

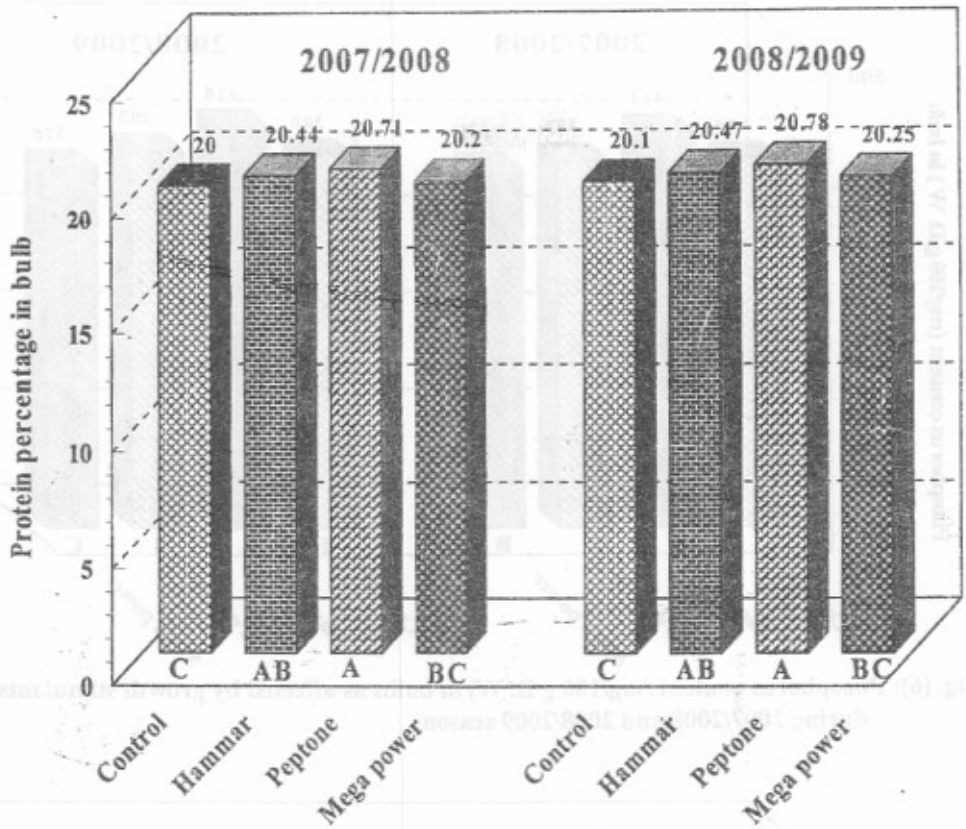

Fig. (8): Protein percentage in bulbs as affected by growth stimulants during 2007/2008 and 2008/2009 seasons.

Table (6): Effect of the interaction between nitrogen levels and some growth stimulants on chemical constituents in bulbs of garlic plants.

N levels (kg/Fed.)	Growth stimulants	2007/2008				2008/2009			
		N (mg)	P (mg)	Protein (%)	NO_3 (ppm)	N (mg)	P (mg)	Protein (%)	NO_3 (ppm)
60	Control	3142^{E}	355^{G}	19.64^{E}	238^{C}	3162^{F}	359^{I}	19.77^{G}	241^{C}
	Hammar	3185^{DE}	386^{DE}	19.91^{DE}	217^{E}	3195^{EF}	390^{DE}	19.97^{F}	218^{E}
	Peptone	3214^{CDE}	350^{G}	20.09^{CDE}	240^{C}	3230^{DE}	370^{GHI}	20.19^{E}	243^{C}
	Mega power	3166^{DE}	368^{EFG}	19.79^{DE}	237^{C}	3164^{EF}	363^{HI}	19.89^{FG}	244^{C}
90	Control	3180^{DE}	393^{CDE}	19.88^{DE}	252^{B}	3198^{EF}	396^{D}	19.99^{EF}	254^{B}
	Hammar	3286^{BC}	409^{BC}	20.54^{BC}	225^{D}	3305^{BC}	418^{BC}	20.66^{CD}	227^{D}
	Peptone	3339^{AB}	380^{EF}	20.87^{AB}	256^{B}	3348^{AB}	381^{EFG}	20.93^{B}	258^{B}
	Mega power	2226^{CD}	365^{FG}	20.17^{CD}	255^{B}	3230^{DE}	376^{FGH}	20.19^{E}	257^{B}
120	Control	3278^{BC}	403^{BCD}	20.49^{BC}	263^{A}	3285^{CD}	410^{C}	20.53^{D}	268^{A}
	Hammar	3337^{AB}	443^{A}	20.86^{AB}	225^{A}	3348^{AB}	448^{A}	20.78^{BC}	273^{A}
	Peptone	3386^{A}	421^{AB}	21.16^{A}	270^{DE}	3393^{A}	428^{B}	21.21^{A}	222^{DE}
	Mega power	3303^{B}	386^{DE}	20.65^{B}	276^{A}	3309^{BC}	387^{DEF}	20.68^{CD}	273^{A}

REFERENCES

Abdel-Mawgoud, A.M.R.; El-Greadly, N.H.M.; Helmy Y.I. and Singer, S.M. (2007): Responses of tomato plants to different rates of humic-based fertilizer and NPK fertilization. Journal of Applied Sciences Research, 3(2): 169-174..

Avdienco V.G.; Avdienco O. V. and Grosheva T.D. (2003): The effect of growth regulator on Potato. Making products of eating. 111-113 (in Russian).

Beames, G.H. (1986): Use of humic substance as agricultural plant bio-stimulants .Eighth Rocky Mountain Regional Meeting. American Chemical Society.17 p.

Bryan, H.H. (1976): Response of tomatoes to seedling applications of humates and alpha keto acids. Proc .Fla. State Hort .Soc.89:87-90.

Cataldo, D.A.; Haroon, M.; Schrader, L.E. and Tounges, V.L. (1975): Rapid colorimetric determination of nitrate in plant tissue by nutrition of salicylic acid. Commune Soil Sci. and Pl. Analysis, 6 (1): 71-80.

Chen, Y. and Aviad, T. (1990): Effect of humic substances on plant growth. Amer. J. Soil Sci., 34 (4):161-186.

David, P.P.; Nelson, P.V. and Sanders, D.C. (1994): Are humic acid improves growth of tomato seedling in solution culture. J. Plant Nutrition.17 (1):173-184.

El-Desuki,. (2004): Response of onion plants to humic acid and mineral fertilizers application. Annals of Agric. Sci., Moshtohor, 42(4):1955-1964.

El-Ghamry, A.M.; Kamar, M.A. and Khalid, M.G. (2009): Amino and humic acids promote growth, yield and disease resistance of faba bean cultivated in clayey soil .Australian Jour. of Basic and Applied Sciences . 3, (2): 731- 739 .

El-Ghozoli, M.A. (2003): Influence of humic acid on faba bean plants grown in cadmium-polluted soil. Annals of Agric. Sci. Moshtohor, 41(4):1787-1800.

Erik, B.G.; Feibert, Clint, C. Shock and Lamont, Saunders, D. (2000): Evaluation of humic acid and other nonconventional fertilizer additives for onion production. Malheur Experiment Station, Oregon State Univ., Ontario, OR.

Gomez, K.A. and Gomez, A.A. (1984): Statistical Procedures for Agricultural Research. (second Ed).John Willy and Sons, New York,pp.680.

Gumminski, S.J.; Suleg and Glabiszew Shi. J. (1983): Influence of sodium humate on uptake of some ions by tomato seedlings. Acta Soc. Bot. Pol. 52:141-164.

Hartwigson, J.A. and Evans, M.R. (2000): Humic acid seed and substrate treatments promote seedling root development. Hort Science, 35 (7):1231-1233.

Havez, M. Magda (2003): Effect of some sources of nitrogen fertilizer and concentration of humic acid on the productivity of squash plants. Egypt .J. Appl .Sci. 19(10): 293-309.

John, M.K. (1970): Calorimetric determination of phosphorus in soil and plant materials with ascorbic acid . Soil Sci., 109: 214-220.

Kaker, A.A.M.K.; Abdullahzai, M. Saleem and Qaim Shah, S.A. (2002): Effect of nitrogenous fertilizer on growth and yield of garlic. Asian Journal of Plant Sciences Vol. 1 Number 5: 544-545..

Kilgori, M.J.; Magaji, M.D. and Yakubu, A.I. (2007): Productivity of two garlic (*Allium sativum* L.) cultivars as affected by different levels of nitrogen and phosphorus fertilizers in Sokoto, Nigeria. American – Eurasian J. & Environ . Sci., 2(2): 158-162.

Koznitsov F.F. (2003): Effect of humic compounds on tomato growth and production under green house conditions. J. Gavrish 2:14-16 (in Russian).

Murashev S. V. (2003): Amino acids improve yields of potato. Making products of eating. 111-113 (in Russian).

Murphy, J. and Riely, J.P. (1962): A modified single solution method for the determination of phosphate in natural water. Anal. Chem. Acta., 27: 31-36.

Nasreen, S.; Haque, M.M.; Hossain, M.A. and Fadid, A.T.M. (2007): Nutrient uptake and yield of onion as influenced by nitrogen and sulphur fertilization. Bangladesh J. Agric. Res. 32(3): 413-420..

Pregl, E. (1945): Quantitative Organic Microanalysis. 4th Ed. J. Chundril, Lonon.

Setty, B.S.; Sulixen and Hulamani, N.C. 1989. Effect of N, P and K on growth and yield of garlic (*Allium sativum* L.). Karntaka, J. Agric. Sci., 2(3):160 (c.f. Hort. Abstr.61 (11). 9951. (1991).

Tugarinof, L.V. (2002): Some aspect lingo-gumat preparation application cropping. J. Gavrish 5:15-17 (in Russian).

Yildirim, E. (2007): Foliar and soil fertilization of humic acid affect productivity and quality of tomato . Acta Agriculturae Scandinavica . Section B . Soil and Plant Science, 27 (2): 182 – 186 .

Zidan, R. and Daiob, S. (2005): Effect of some humate substances and amino acids on growth and yield of potato *(Solanum tuberosum* L.) . Tashreen Univ. Jour. Bio . Sci. Series . 27 (2), 2005 .

استجابة نباتات الثوم لتأثير مستويات التسميد النيتروجين وبعض محفزات النمو

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أجريت تجربتان حقليتان في محطة التجارب الزراعية بقها محافظة القليوبية، مصر خلال الموسم الشتوى لعامى ٢٠٠٧/ ٢٠٠٨ و٢٠٠٨/٢٠٠٩ لدراسة تأثير مستويات التسميد النيتروجيني والرش ببعض محفزات النمو على صفات النمو الخضرى والمحصول والمحتوى الكيماوي للثوم صنف سدس ٤٠.

- أوضحت النتائج المتحصل عليها أن زيادة مستوى التسميد النيتروجيني من ٦٠ حتى ١٢٠ كجم نيتروجين/ فدان أدى إلى التحصل على زيادة معنوية في كل صفات النمو الخضري المدروسة، ولكن هذه الزيادة لم تصل لمستوى المعنوية في حالة النسبة المئوية للمادة الجافة خلال الموسم الأول، وعدد الأوراق/ نبات خلال الموسم الثاني وأظهرت النتائج أيضا أن رش نباتات الثوم بمادة البيتون بمعدل ٠,٥ جم/ لتر قد حقق أعلى القيم في جميع قياسات النمو المدروسة، يليها الرش بمادة الهمر بمعدل ٠,٢٥ جم/ لتر، وذلك مقارنة باستخدام مادة ميجاباور (١,٥ سم/ لتر) أو معاملة الكنترول.
- أظهرت النتائج أن تسميد نباتات الثوم بمعدل ١٢٠ كجم نيتروجين/ فدان بالإضافة إلى الرش بأي من البيتون (٠,٥ جم/ لتر) أو الهمر (٠,٢٥ جم/ لتر) قد حقق أعلى القيم الخاصة بصفات النمو الخضري المدروسة خلال موسمي الدراسة. من ناحية أخرى لم تتأثر جميع صفات البصلة المدروسة معنوياً عند زيادة مستوى السماد النيتروجيني من ٦٠ حتى ١٢٠ كجم/ فدان خلال موسمي الدراسة، بينما اظهر رش النباتات بمادة البيتون بمعدل ٠,٥ جم/ لتر أعلى القيم في هذا الجانب، ومع ذلك فانه لم تكن هناك فروقاً معنوية في صفات البصلة عند إضافة السماد النيتروجين بمعدل ٩٠ أو ١٢٠ كجم مع الرش بمادة البيتون.
- أدى تسميد نباتات الثوم بمعدل ٩٠ أو ١٢٠كجم نيتروجين/ فدان + رش النباتات ثلاث مرات بمادة البيتون ٠,٥ جم/ لتر قد انعكس ذلك في تحقيق أعلى القيم الخاصة بمتوسط وزن الفص، الوزن الطازج للفص والنسبة المئوية للمادة الجافة للأبصال والمحصول الكلي للفدان.
- كما أدى استخدام المعدل العالي من السماد النيتروجيني (١٢٠ كجم/ فدان) إلى تسجيل أعلى القيم في كل الصفات الكيماوية المدروسة على الأبصال خلال موسمي الدراسة.
- أدى رش نباتات الثوم بمادة الهامر بمعدل ٠,٢٥ جم/ لتر إلى زيادة تركيز الفوسفور وخفض تركيز النترات في الأبصال خلال موسمي الدراسة مقارنة بمعاملات الرش بمحفزات النمو المستخدمة.
- أظهرت النتائج أن إضافة أعلى معدل من السماد النيتروجيني (١٢٠ كجم/ فدان) + الرش بأي من الهمر أو البيتون أعطى أعلى القيم لجميع قياسات التركيب الكيماوي (النيتروجين الكلي، الفوسفور، البروتين، والنترات في أبصال الثوم.