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EFFECT OF CHICKEN MANURE LEVELS, BIOFERTILIZERS AND SOME FOLIAR APPLICATION TREATMENTS ON GARLIC
1. PLANT GROWTH AND LEAF PIGMENTS

Dawa, K. K.[*] ; E. A. A. Radwan[**] and F. Y. O. Mansour[**]
[*] Vegetables and Ornamentals Dept., Fac. Agric., Mans. Univ., Egypt
[**]Potato and Vegetatively Propagated Veget., Hort. Res. Inst., Agric. Res. Center , Egypt

ABSTRACT

Two field experiments were carried out during the two successive winter seasons of 2008/2009 and 2009/2010 at El-Gemmeiza Agricultural Research Station, Gharbeya Governorate, to evaluate the effect of chicken manure levels, biofertilizers, some foliar application treatments and their interactions on plant growth and leaf pigments of garlic (*Allium sativum* L.) Sids 40 clone.

The obtained results showed that the highest values of plant height, number of leaves/ plant, leaf area , fresh and dry weights/plant, neck and bulb diameters at 105 and 135 days after planting in both seasons and dry weight of bulb at 135 days after planting, chlorophyll a, b and total (a+b) as well as carotenoides were recorded with the highest nitrogen rate (120 kg N/fed.) in the form of chicken manure at 4.137 ton/fed. or mineral N (control). Inoculation of garlic cloves with biofertilizers caused a high significant effect on all plant growth characters and leaf pigments as compared to uninoculated plants. Spraying garlic plants with yeast extract significantly increased plant height, number of leaves/ plant, fresh and dry weights/ plant, neck and bulb diameter as well as dry weight of bulb at 135 days after planting, chlorophyll a, b and total (a+b) as well as carotenoides in both season followed with spraying seaweed extract treatment.

The best results of vegetative parameters were obtained with application of nitrogen fertilizer at 120 kg N/fed. of chicken manure at rate of 4.137 ton/fed. or mineral nitrogen with biofertilizers and foliar application of yeast extract. Therefore, this treatment could be recommended for improving garlic vegetative growth parameters under similar conditions to this study.

Keywords: Garlic , *Allium sativum*, chicken manure levels, biofertilizers, yeast extract, seaweed extract, plant growth and leaf pigments**.**

INTRODUCTION

Garlic (Allium sativum L.) is considered as one of the most important species in the onion family Alliaceae. It is an important vegetable bulb crop and is next to onion in importance. Increasing garlic production has become of great necessary to meet the ever increased demand of exportation and local consumption (El-Hifny, 2010).

Excessive amounts of inorganic fertilizers are applied to vegetables in order to achieve a higher yield. However, chemical fertilizers alone generate several deleterious effects to the environment and human health and also should be replenished in every cultivation season since, the synthetic N, P and K fertilizer is rapidly lost by either evaporation or by leaching in drainage

water causing dangerous environmental pollution (Aisha *et al*., 2007). Addition of organic fertilizers improves soil structure and enhances activities of useful soil organisms. Agricultural commodities resulted from organic cultivation are good for human health.

Application of nitrogen as chicken manure or mineral N up to 120 kg N/fed. significantly increased plant height, number of leaves/ plant, leaf area/ plant , fresh and dry weight / plant as well as bulb and neck diameter (El-Mansi *et al*., 2004; Hassan, 2005; Shashidhar *et al*., 2009; Suthar, 2009 and Bardisi *et al*., 2011) and leaf garlic pigments (El-Mansi *et al*., 2004 and Bardisi *et al*., 2011).

Biofertilizers contains *Azotobacter sp*., Mycorrhizae (VAM) , *Bacillus megatherium* phosphate -dissolving bacteria and silicate -dissolving bacteria could be used instead of chemical fertilizers. Moreover, these bacterial cells increase the availability of nutrients in form which can be easily assimilated by plants (Subba Rao, 1993). Inoculation of garlic plants with different biofertilizers significantly increased all plant growth parameters of garlic (El-Shabasi *et al*., 2003); El-Seifi *et al*., 2004; Midan, 2007; Gouda, 2008; Ortas, 2008; El-Morsy *et al*., 2009; Mahesh *et al*., 2009 and Mohsen *et al.*, 2011) as well as leaf pigments of garlic (Gouda, 2008).

Yeast and seaweed extracts are a new biostimulants containing N, P, K, Ca, Mg, S, Zn, Fe, Mn, Cu, Mo, and Co, some growth regulators, polyamines and vitamins was applied to improve nutritional status and vegetative growth (Spinelli *et al*., 2009). Spraying garlic plants with green micro algae extract at 0.2 % was the best treatment for enhancing dry weight of leaves, bulb and total (leaves + bulb) / plant of garlic as well as chlorophyll a, b and total (a+b) in leaf tissues (Abou El-Khair *et al.*, 2010). Foliar application of yeast extract on garlic plants at 50 ml/L gave rise to significant increase in plant height , number of leaves/ plant , bulbing ratio and plant dry weight compared with the other treatments ,i.e., 25 or 100 ml/L. (El-Morsy *et al*. , 2011)

The objective of this investigation was to determine suitable amount and source of nitrogen as well as biofertilizers and foliar spray with yeast and seaweed extracts to obtain good plant growth and leaf pigments of garlic.

MATERIALS AND METHODS

Two field experiments were carried out during the two successive winter seasons of 2008/2009 and 2009/2010 at El-Gemmeiza Agricultural Research Station, Gharbeya Governorate, to evaluate the effect of chicken manure levels, biofertilizers, some foliar application treatments and their interactions on plant growth and leaf pigments of garlic (*Allium sativum* L.) Sids 40 clone.

The physical and chemical properties of the experimental soil are presented in Table (1).

The experimental layout was split split system in a randomized complete blocks design with three replicates. The levels of chicken manure occupied the main plots, which were subdivided to two sub plots each contained one of the biofertilizers, while the biostimulant extracts treatments

were randomly assigned in the sub sub plots. The sub sub plots area was 10.5 m^2 it was contained five rows with 3.5 meter length and 60 cm in width. The experiment includes 24 treatments, which were the combinations of 4 chicken manure levels x 2 biofertilizers rate x 3 foliar application (biostimulant extracts).

Table 1: The physical and chemical properties of the experimental soil in 2008/2009 and 2009/2010 seasons

Season	O.M (%)	Clay (%)	Silt (%)	Sand (%)	Texture class	E.C mmohs/ cm	pH	Available (ppm)		
								N	P	K
1st	1.48	52.83	25.67	21.50	Clay loam	1.40	7.89	8.19	0.032	0.54
2nd	1.56	54.01	23.96	22.03		1.46	7.99	9.52	0.029	0.51

Three chicken manure levels (60, 90 and 120 kg N/fed. were about 2.068, 3.100 and 4.137 ton chicken manure/fed.) and a good decomposition. In addition to, the control treatment (120 kg/fed. the recommended dose of mineral N) were used in this study. Chicken manure was obtained from El-Gemmeiza poultry Station. The biofertilizers treatment involved a mixture of beneficial microorganisms including *Azotobacter* which fixes nitrogen by a free manner *; Bacillus circulanc* bacteria which make potassium more available and mycorrhizae fungi which increases phosphorus and many nutrients approbation. All inoculums were provided by the Unit of Biofertilizer, Faculty of Agricultural, Ain Shams University, Egypt. Cloves were dipped in biofertilizers solution (mixture of the previous motioned microorganisms before planting and the treated cloves were directly planted in the same day. Another application was added beside the plants after 21 days from planting before irrigation. Three foliar applications including the control treatment (tap water spray only), seaweed extract (commercial name Gesemar). It contain 6.5 % free amino acid , nitrogen 5.8 %, phosphorus 3 % , potassium 4.6 % and boron 0.17 % . Seaweed extracts used at the rate of 400 ml/fed. and yeast extract. Preparation of yeast solution was done according to El-Ghamriny *et al*. (1999). It was used at concentration of 50 ml/l. Plants were sprayed with seaweed and yeast extracts five times, beginning one month after planting and ten days intervals.

Table 2: The chemical analysis of chicken manure during the two seasons

Season	Macro elements (%)			Micro elements (ppm)				O.M. (%)
	N	P	K	Fe	Mn	Zn	Cu	
1st	2.87	0.96	1.28	1104	210	209	41	35.90
2nd	2.93	1.02	1.17	1066	206	221	43	37.57

Sids 40 clone were obtained from Horticultural Research Institute. Garlic cloves were selected for uniformity in shape and size. The cloves were planted on one side of the rows at distance of 10 cm apart. Planting was done on the first week of October in both seasons.

During soil preparation the different chicken manure levels were added and all experimental units received equal amounts of natural rock fertilizers, *i.e.,* rock phosphate and feldspar rock at the rate of 75 and 72 kg/fed., respectively .

Mineral N at the rate of 120 kg/fed. was added at three portions in the form of ammonium sulfate (20.6 % N). One third was added during soil preparation. The two other thirds of mineral N were added one month intervals beginning one month after sowing. The other cultural practices for garlic commercial production were used according to the instruction laid down by the Ministry of Agriculture, Egypt**.**

Data recorded

Growth Parameters

Two random samples of five plants were randomly taken from each plot at 105 and 135 days after planting in both seasons of study for measuring the growth characters of garlic plants ,i.e., plant height (cm), leaf number /plant, leaf area (cm^2 /plant) according to Koller (1972). and bulb characteristics, i.e., neck diameter (cm), bulb diameter (cm) and bulbing ratio (neck diameter/bulb diameter according to Mann (1952).

Dry weight of bulb (gm) at 135 days only

Leaf Pigments

A disc sample from the fourth outer leaf of garlic plant was randomly taken from every experimental unit at 120 days after planting in both growing seasons to determine chlorophyll a and b as well as carotenoids according to the method described by Wettestein (1957).

Statistical analysis: the data of both experiments were subjected to proper statistical analysis of variance according to Snedecor and Cochran (1980). The treatments means were compared using least significant difference (LSD) at 5 % level method as mentioned by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Plant growth

Effect of chicken manure levels

Results obtained in Tables (3 and 4) showed that application of chicken manure at different rates affected significantly the plant growth parameters expressed as plant height, number of leaves/ plant, leaf area and fresh and dry weights/plant at the two sampling dates (105 and 135 days after planting) in both growing seasons. It is cleared that the different growth parameters mentioned in Tables (3 and 4) were significantly increased with increasing application rates of chicken manure (ChM) up to 4.137 ton/fed. (120 kg N/fed.), since the highest values of plant height, number of leaves/ plant, leaf area/ plant and fresh and dry weights/plant were recorded with the highest nitrogen rate of 4.137 ton/fed. (120 kg N/fed.) for both chicken manure and control at 105 and 135 days after planting in both seasons. It is also cleared that non significant differences were detected between the highest chicken manure rate at 4.137 ton/fed. as organic N (120 kg N/fed.) and control treatment as mineral N (120 kg recommended mineral nitrogen) on all measured parameters , except the fresh and dry weights at 105 days

after planting in both seasons. However, increasing chicken manure rates at 3.100 ton/fed. (90 kg N/fed.) gave medium values of all growth parameters in both seasons.

Table 3: Effect of chicken manure (ChM) levels, biofertilizers and foliar applications on plant grwoth of garlic during 2008/2009 season

Characters / Treatments	Plant height (cm)		Number of leaves/plant		Leaf area (cm^2)		Fresh weight/ plant (g)		Dry weight /plant (g)	
	Days after planting									
	105	135	105	135	105	135	105	135	105	135
Chicken manure levels (kg N/fed.)										
Control (120 kg /fed. mineral N)	60.37	91.70	7.89	9.68	499.35	695.13	82.79	111.75	6.71	25.57
ChM at 2.068 ton/fed. (60 kg N)	47.60	79.89	6.54	8.32	473.82	674.89	64.81	93.83	5.44	21.59
ChM at 3.100 ton/fed. (90 kg N)	56.14	87.80	7.11	8.91	485.08	680.72	70.37	100.25	5.83	23.05
ChM at 4.137 ton/fed. (120 kg N)	59.64	91.27	7.81	9.62	498.03	693.57	80.45	111.66	6.54	25.57
LSD at 0.05 level	**0.91**	**1.14**	**0.34**	**0.66**	**8.55**	**19.69**	**1.01**	**1.12**	**0.17**	**0.38**
Biofertilizers										
Without	54.82	86.46	7.17	8.94	485.47	683.84	72.87	102.44	6.01	23.54
With (Az+Bac.+VAM)	57.07	88.87	7.50	9.33	492.67	688.31	76.34	106.30	6.25	24.35
F. test	*	*	*	NS	*	NS	*	*	*	*
Foliar applications										
Without (sprayed with tap water)	51.64	83.78	6.96	8.81	484.30	684.00	68.55	97.45	5.71	22.44
Seaweed extract	55.71	87.37	7.42	9.18	490.53	685.85	76.33	106.50	6.24	24.43
Yeast extract	60.47	91.85	7.64	9.42	492.39	688.39	78.92	109.17	6.43	24.97
LSD at 0.05 level	**0.72**	**0.90**	**0.27**	**0.53**	**6.68**	**NS**	**0.81**	**1.77**	**0.15**	**0.33**

Az: Azotabacter, Bac: Bacillus, VAM: Mycrrohiaze

Concerning the effect of chicken manure rates on bulbing characters of garlic plants at 105 and 135 days after planting, the obtained results in Table (5) indicated that the neck and bulb diameters of values were significantly affected in both seasons by increasing chicken manure rates up to 4.137 ton/fed. (120 kg N/fed.), since the highest values were recorded at the two sampling dates. It was also shown that non significant differences were recorded between the control treatment (mineral N at 120 kg/fed.) and the highest chicken manure rate (4.137 ton/fed.) in this concern.

Regarding the effect of nitrogen fertilizer on the bulbing ratio, the same data in Table (5) showed that non significant differences were recorded among all treatments in both growing seasons , except at 135 days after planting in the second season, where the lowest and best figure of bulbing ratio was found with the application of ChM at rate of 3.100 ton/fed. (90 kg N/fed.) as for the dry weight of bulb, data in Table (5) showed that the highest significant dry weight value of bulb (g) at 135 days after planting were obtained with the highest chicken manure rate at 4.137 ton/fed. (120 kg N/fed.) as compared to the other two rates of 2.068 and 3.100 ton/fed. (60

and 90 kg N/fed.) and the control treatment (120 kg mineral N). These results were true in both seasons.

Table 4: Effect of chicken manure (ChM) levels , biofertilizers and foliar applications on plant grwoth of garlic during 2009/2010 season

Characters	Plant height (cm)		Number of leaves/plant		Leaf area (cm^2)		Fresh weight/ plant (g)		Dry weight /plant (g)	
	Days after planting									
Treatments	**105**	**135**	**105**	**135**	**105**	**135**	**105**	**135**	**105**	**135**
Chicken manure levels (kg N/fed.)										
Control (120 kg /fed. mineral N)	58.15	87.23	7.61	9.45	505.08	701.97	79.12	106.73	4.79	22.13
ChM at 2.068 ton/fed. (60 kg N)	45.36	74.89	6.26	8.07	479.89	676.40	61.05	88.49	3.54	18.18
ChM at 3.100 ton/fed. (90 kg N)	53.92	83.36	6.83	8.67	485.48	687.55	66.67	94.77	3.98	19.54
ChM at 4.137 ton/fed. (120 kg N)	57.36	86.86	7.54	9.41	506.31	700.35	76.71	105.97	4.63	22.14
LSD at 0.05 level	**1.25**	**0.81**	**0.12**	**0.48**	**15.25**	**14.11**	**0.54**	**0.61**	**0.07**	**0.10**
Biofertilizers										
Without	52.56	82.02	6.89	8.72	488.54	687.97	69.09	97.30	4.13	20.09
With (Az+Bac.+VAM)	54.84	84.15	7.23	9.09	499.85	695.17	72.68	100.68	4.34	20.90
F. test	*	*	*	*	NS	NS	*	*	*	*
Foliar applications										
Without (sprayed with tap water)	49.41	78.92	6.68	8.57	490.83	686.68	64.87	92.32	3.84	19.00
Seaweed extract	53.48	82.92	7.14	8.96	492.63	692.81	72.60	101.04	4.33	20.95
Yeast extract	58.21	87.41	7.36	9.18	499.12	695.21	75.19	103.61	4.54	21.54
LSD at 0.05 level	**0.69**	**0.79**	**0.10**	**0.40**	**NS**	**NS**	**0.37**	**0.56**	**0.05**	**0.09**

Az: Azotabacter, Bac: Bacillus, VAM: Mycrrohiaze

These results could be attributed to the role of chicken manure as organic fertilizer in improving soil texture, water holding capacity, and it creates good aeration in the soil. Also, to the slow release of the nutrients resulted from the chicken manure by the biodegrading of soil microorganisms which creates favorable conditions for nutrient uptake to plant roots and reflects better photosynthetic activity which in turn resulted in a higher vegetative growth. Similar results are recorded by (El-Hifny 2010) who found that the different growth parameters improved with increasing application rate of N/fed. up to 120 kg N/fed. The obtained data are in harmony with those reported by El-Mansi *et al*. (2004), Hassan (2005), Shashidhar *et al*. (2009), Suthar (2009) and Bardisi *et al*. (2011) on garlic, Kader *et al*., (2002), El-Shabasi *et al*. (2003) and El-Seifi *et al*. (2004) obtained similar results using mineral nitrogen fertilizer.

Effect of biofertilizers

Such data in Tables (3 and 4) demonstrated that inoculation of garlic with biofertilizers (*Azotobacter*+ *Bacillus*+ *Mycorrhizae)* caused a high significant effect on plant height, number of leaves/plant, leaf area, fresh and

dry weights/plant, except leaf area compared with untreated plants at the two sampling dates. This trend was true in the two growing seasons.

Concerning the effect of biofertilizer (triple inoculation) on bulbing characters of garlic plants at 105 and 135 days after planting in the two experimental seasons. The obtained results in Table (5) cleared the effect of inoculation with biofertilizers on neck diameter, bulb diameter, bulbing ratio and dry weight of bulb. Such data showed that no significant differences were recorded between the inoculation with triple biofertilizers treatment and the untreated plants on all characters, except on dry weight of bulb at 135 day after planting in both growing seasons and neck diameter at 105 days after planting in the second season only.

Table 5: Effect of chicken manure (ChM) levels , biofertilizers and foliar applications on bulb characters of garlic plants during 2008/2009 (S1) and 2009/ 2010 (S2) seasons

Characters	Neck diameter (cm)				Bulb diameter (cm)				Bulbing ratio		Dry weight of bulb (g)			
	Days after planting													
	105		135		105		135		105		135		135	
Treatments	S 1	S 2	S 1	S 2	S 1	S 2	S 1	S 2	S 1	S 2	S 1	S 2	S 1	S 2
Chicken manure levels (kg N/fed.)														
Control (120 kg /fed. mineral N)	1.23	1.08	1.63	1.42	1.89	1.68	4.70	4.46	0.649	0.647	0.349	0.320	9.16	7.90
ChM at 2.068 ton/fed. (60 kg N)	1.13	0.99	1.49	1.27	1.75	1.57	4.12	3.86	0.649	0.630	0.362	0.329	7.84	6.64
ChM at 3.100 ton/fed. (90 kg N)	1.15	1.03	1.55	1.36	1.80	1.65	4.62	4.39	0.642	0.629	0.336	0.310	8.46	7.15
ChM at 4.137 ton/fed. (120 kg N)	1.20	1.07	1.63	1.48	1.87	1.74	4.72	4.50	0.642	0.619	0.345	0.329	9.43	8.19
LSD at 0.05 level	**0.08**	**0.02**	**0.05**	**0.05**	**0.07**	**0.09**	**0.10**	**0.16**	**NS**	**NS**	**NS**	**0.002**	**0.22**	**0.08**
Biofertilizers														
Without	1.17	1.03	1.57	1.36	1.82	1.64	4.52	4.27	0.643	0.632	0.348	0.319	8.58	7.32
With (Az+Bac.+VAM)	1.19	1.06	1.58	1.40	1.84	1.68	4.56	4.33	0.648	0.630	0.348	0.324	8.86	7.62
F. test	**NS**	*	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	*	*
Foliar applications														
Without (sprayed with tap water)	1.15	1.01	1.52	1.32	1.78	1.57	4.49	4.26	0.648	0.645	0.339	0.311	8.14	6.88
Seaweed extract	1.18	1.05	1.59	1.40	1.83	1.69	4.55	4.30	0.647	0.627	0.351	0.327	8.93	7.67
Yeast extract	1.20	1.07	1.61	1.42	1.87	1.72	4.58	4.35	0.642	0.622	0.354	0.328	9.09	7.87
LSD at 0.05 level	**0.03**	**0.02**	**0.04**	**0.05**	**0.05**	**0.05**	**0.08**	**0.07**	**NS**	**NS**	**0.010**	**NS**	**0.18**	**0.09**

Az: Azotabacter, Bac: Bacillus, VAM: Mycrrohiaze

The stimulating effect of biofertilizer on the plant growth parameters may be due to the effect of different strains such as nitrogen fixes, nutrient mobilizing microorganisms, which help in availability of total and their forms in the composted materials and hence , increased the levels of extractable N,P, K and Fe, Mn, Cu…etc as macro-and micro-nutrients. (Warade *et al*., 1996). Also, the increment in vegetative growth due to the vital role

bacteria present in the applied biofertilizer and capable of contributing some hormone substances, that is Gibberellins, auxins and cytokines (Cacciari *et al*., 1989). These phytohormones may stimulate the cell elongation and development and hence, plant growth (Paleg, 1985) These results are in agreement with those of Koch *et al*. (1997), El-Shabasi *et al*. (2003), El-Seifi *et al*. (2004), Midan (2007), Gouda (2008), Ortas (2008), El-Morsy *et al*. (2009), Mahesh *et al*. (2009) and Mohsen *et al.* (2011) on garlic.

Effect of foliar application

Spraying garlic plants with seaweed and yeast extracts significantly increased all growth parameters including plant height, number of leaves/ plant, and fresh and dry weights/ plant in the two growing seasons compared with unsprayed plants as presented in Tables (3 and 4). Leaf area was not significantly affected by the different treatments except at 105 days after planting in the first season. Data clearly showed that the highest significant values of plant height, number of leaves/ plant, and fresh and dry weights/ plant were recorded with spraying yeast extract at 105 and 135 days after planting in both growing seasons followed with spraying seaweed extract treatment. The lowest values were recorded with untreated plants (spraying with water).

Concerning the effect of biostimulant extracts (yeast and seaweed) as foliar application on bulbing characters of garlic plants at 105 and 135 days after planting in the two growing seasons, data on the previous characters are presented in Table (5). It is clear from the results that all sprayed plants with seaweed extract or yeast extract had significant higher values of all investigated bulbing characters of garlic plants in both studying seasons , except that of bulbing ratio at 105 days after planting in the first season and at 105, 135 days after planting in the second season. The highest values of neck diameter, bulb diameter and dry weight of bulb were recorded with spraying plants by yeast extract in both growing seasons, while the lowest values of these characters were found with unsprayed plants (sprayed with tap water). It also shown that non significant differences were recorded between the two foliar treatments.

The obtained results may be due to that yeast is considered as a natural source of cytokinins that stimulates cell division and enlargement as well as the synthesis of protein , nucleic acid and chlorophyll, also it contains sugar, proteins, amino acids and vitamins, especially B which may play an important role in improving growth (Fathy and Farid, 1996). These results are in agreement with those of Abou El-Khair *et al*. (2010) and El-Morsy *et al*. (2011) on garlic

Triple interaction effect

Data presented in Tables (6 and 7) that there were no clear significant response on all measured parameters as affected by three tested factors at 105 days after planting in both seasons, except the fresh weight in the second season. Meanwhile, there were a significant effects on all vegetative characters at 135 days after planting except the leaf area in both experimental seasons. Also, the results in Tables (6, 7) showed that either chicken manure at the highest rate of 4.137 ton/fed. (120 kg N/fed.) or mineral N fertilizer (120 kg N/fed.) as a fertilizer source with the presence of

biofertilizers and spraying with yeast extract gave a positive increment in all measured parameters, since the highest values of plant height, number of leaves/plant, fresh and dry weights/ plant were recorded without significant difference between both treatments.

Table 6: Effect of triple interaction among chicken manure (ChM) levels , biofertilizers and foliar applications on plant growth characters of garlic during 2008/2009 season

Treatments		Characters	Plant height (cm)		Number of leaves/plant		Leaf area (cm^2)		Fresh weight/ plant (g)		Dry weight /plant (g)	
			Days after planting									
Kg N /fed.	Biofertilizers	Foliar applictaions	105	135	105	135	105	135	105	135	105	135
Control*	Without	Without	55.06	86.58	7.16	8.94	490.48	686.01	73.99	101.72	6.12	23.38
		Seaweed	59.11	90.81	7.94	9.72	496.45	691.98	82.30	111.22	6.66	25.46
		Yeast	63.48	95.05	8.20	9.98	498.09	694.41	84.84	114.34	6.84	26.16
	With	Without	57.08	88.63	7.68	9.47	497.71	693.25	78.60	108.00	6.41	24.69
		Seaweed	61.21	92.81	8.15	9.93	505.74	699.42	87.57	116.85	7.03	26.71
		Yeast	66.30	96.33	8.25	10.03	507.62	705.75	89.43	118.38	7.18	27.02
60	Without	Without	42.26	74.45	6.10	7.85	466.33	695.18	57.07	85.67	4.90	19.85
		Seaweed	46.50	78.16	6.33	8.13	471.59	667.09	64.51	93.84	5.42	21.64
		Yeast	50.66	82.33	6.63	8.39	474.30	669.80	67.74	96.93	5.65	22.32
	With	Without	44.20	79.08	6.51	8.32	472.37	667.90	60.16	88.98	5.12	20.57
		Seaweed	48.27	80.03	6.73	8.50	478.10	673.60	68.09	97.08	5.66	22.36
		Yeast	53.71	85.28	6.93	8.76	480.27	675.77	71.29	100.51	5.89	22.78
90	Without	Without	51.21	82.56	6.60	8.41	477.45	672.95	63.56	92.77	5.35	21.42
		Seaweed	55.00	86.60	6.83	8.60	483.53	679.03	70.75	101.03	5.85	23.22
		Yeast	59.16	90.71	7.13	8.90	485.21	680.74	73.93	103.41	6.07	23.75
	With	Without	52.70	84.78	7.01	8.86	484.12	679.73	66.38	95.52	5.55	22.01
		Seaweed	56.77	88.56	7.46	9.35	489.58	685.27	73.39	103.55	6.04	23.79
		Yeast	62.04	93.60	7.61	9.38	490.61	686.61	74.23	105.20	6.11	24.10
120	Without	Without	54.31	86.08	7.10	9.14	489.66	685.17	72.70	101.37	5.99	23.38
		Seaweed	58.34	89.90	7.94	9.23	495.46	691.11	80.14	112.11	6.51	25.66
		Yeast	62.71	94.28	8.11	9.96	497.12	692.67	82.95	114.91	6.72	26.28
	With	Without	56.32	88.08	7.51	9.48	496.28	691.86	75.99	105.55	6.22	24.22
		Seaweed	60.50	92.06	7.98	9.98	503.78	699.28	83.95	116.32	6.77	26.59
		Yeast	65.70	97.25	8.25	9.96	505.91	701.36	86.99	119.69	7.02	27.33
LSD at 0.05 level			NS	2.55	NS	1.49	NS	NS	NS	2.50	NS	0.92

Control * (120 kg recommended mineral nitrogen)

Spraying garlic plants with seaweed extracts and inoculation with biofertilizer plus the highest nitrogen rate as form of ChM (4.137 ton/fed.) came in the second rank , while the lowest values of all vegetative parameters were recorded with lowest organic nitrogen rate (60 kg N/fed.) without biofertilizers or foliar applications in both growing seasons.

Concerning the effect of interaction among chicken manure rates, biofertilizers and foliar application on bulbing parameters of garlic plants, data presented in Table (8) that there were no clear significant response in all measured parameters as affected by these interactions at different sampling dates in both seasons except the bulb diameter and dry weight of bulb at 135 days after planting in both seasons. Also, the results in Table (8) showed that either chicken manure at the highest level of 4.137 ton/fed. (120 kg

N/fed.) or mineral N (120 kg/fed.) as a fertilizer source with the presence of biofertilizers and spraying with yeast extract gave a positive increment in all measured parameters without significant differences between both treatments. Fertilization of garlic plants with chicken manure at lowest level of 2.068 ton/fed. (60 kg N/fed.) without biofertilizers or foliar application gave the lowest values of bulbing characters in both seasons.

Table 7: Effect of triple interaction among chicken manure (ChM) levels , biofertilizers and foliar applications on plant growth characters of garlic during 2009/ 2010 season

Treatments		Characters	Plant height (cm)		Number of leaves/plant		Leaf area (cm^2)		Fresh weight/ plant (g)		Dry weight / plant (g)	
			Days after planting									
Kg N /fed.	Biofertilizers	Foliar applictaions	105	135	105	135	105	135	105	135	105	135
Control*	Without	Without	52.84	82.14	6.88	8.74	480.75	692.85	70.22	96.32	4.17	20.14
		Seaweed	56.89	86.22	7.66	9.49	505.25	698.80	78.52	105.83	4.71	21.96
		Yeast	61.26	90.60	7.92	9.75	506.94	701.26	81.01	108.82	5.01	22.66
	With	Without	54.86	84.18	7.40	9.21	506.53	700.08	74.85	102.63	4.56	21.21
		Seaweed	58.99	88.38	7.87	9.70	514.60	706.27	84.33	111.50	5.05	23.23
		Yeast	64.08	91.89	7.97	9.80	516.46	712.58	85.78	112.93	5.24	23.61
60	Without	Without	40.04	70.01	5.82	7.61	475.21	668.66	53.45	80.36	3.05	16.38
		Seaweed	44.28	73.72	6.05	7.90	480.42	675.25	60.46	88.48	3.50	18.16
		Yeast	48.44	77.88	6.35	8.16	483.13	676.61	64.14	91.63	3.72	18.85
	With	Without	41.98	71.30	6.23	8.08	481.20	674.90	56.52	83.64	3.20	17.13
		Seaweed	45.94	75.59	6.45	8.23	486.95	680.45	64.36	91.78	3.76	18.91
		Yeast	51.48	80.84	6.65	8.45	472.46	682.52	67.39	95.06	4.02	19.66
90	Without	Without	48.99	78.12	6.32	8.18	486.27	679.77	59.82	87.40	3.61	17.96
		Seaweed	52.78	82.16	6.55	8.35	441.75	685.85	66.91	95.78	4.03	19.77
		Yeast	56.83	86.27	6.84	8.65	494.09	687.55	70.10	98.18	4.22	20.25
	With	Without	50.48	80.34	6.73	8.60	492.92	686.58	62.78	90.08	3.65	18.47
		Seaweed	54.54	84.12	7.19	9.12	498.38	692.11	69.66	97.90	4.15	20.24
		Yeast	59.89	89.16	7.33	9.15	499.47	693.45	70.73	99.26	4.23	20.54
120	Without	Without	51.99	81.64	6.83	8.91	498.49	691.92	68.97	96.07	4.11	19.95
		Seaweed	56.12	85.60	7.65	9.14	504.46	697.71	76.40	106.79	4.59	22.22
		Yeast	60.24	89.84	7.84	9.73	505.71	699.41	79.15	109.58	4.82	22.85
	With	Without	54.10	83.64	7.24	9.21	505.25	698.66	72.37	99.71	4.36	20.78
		Seaweed	58.27	87.62	7.69	9.75	509.25	706.09	80.13	110.29	4.84	23.14
		Yeast	63.47	92.81	7.97	9.73	514.72	708.32	83.24	113.39	5.10	23.88
LSD at 0.05 level			NS	2.21	NS	1.12	NS	NS	1.04	1.55	NS	0.25

Table 8: Effect of triple interaction among chicken manure (chM) levels , biofertilizers and foliar applications on bulb characters of garlic plants during 2008/2009 (S1) and 2009/ 2010 (S2) seasons

Treaments / Charcaters			Neck diameter (cm)				Bulb diameter (cm)				Bulbing ratio				Dry weight of bulb (g)	
Kg N/fed.	Biofertilizers	Foliar applictaions	Days after planting													
			105		135		105		135		105		135		135	
			S 1	S 2	S 1	S 2	S 1	S 2	S 1	S 2	S 1	S 2	S 1	S 2	S 1	S 2
Control *	Without	Without	1.17	1.02	1.58	1.36	1.83	1.61	4.62	4.38	0.640	0.635	0.342	0.311	8.31	7.32
		Seaweed	1.20	1.07	1.61	1.40	1.88	1.67	4.68	4.44	0.641	0.642	0.344	0.316	9.10	7.85
		Yeast	1.23	1.08	1.64	1.43	1.94	1.72	4.72	4.49	0.636	0.631	0.348	0.319	9.40	8.15
	With	Without	1.21	1.07	1.62	1.41	1.85	1.63	4.66	4.42	0.656	0.659	0.349	0.319	8.87	7.62
		Seaweed	1.26	1.12	1.67	1.46	1.90	1.70	4.74	4.50	0.665	0.660	0.353	0.324	9.57	8.32
		Yeast	1.28	1.14	1.69	1.48	1.95	1.73	4.77	4.53	0.656	0.658	0.354	0.328	9.70	8.46
60	Without	Without	1.11	0.96	1.42	1.22	1.71	1.49	4.07	3.83	0.649	0.644	0.349	0.318	7.28	6.03
		Seaweed	1.14	0.99	1.56	1.29	1.74	1.55	4.10	3.71	0.652	0.639	0.380	0.350	7.88	6.63
		Yeast	1.15	1.00	1.58	1.32	1.78	1.58	4.15	3.91	0.643	0.636	0.381	0.339	8.12	6.87
	With	Without	1.12	0.97	1.43	1.23	1.72	1.51	4.09	3.86	0.650	0.640	0.350	0.320	7.56	6.31
		Seaweed	1.14	1.01	1.46	1.27	1.76	1.64	4.14	3.93	0.651	0.616	0.354	0.324	8.15	6.90
		Yeast	1.16	1.01	1.48	1.28	1.79	1.67	4.17	3.96	0.647	0.604	0.356	0.325	8.06	7.14
90	Without	Without	1.13	0.99	1.45	1.26	1.74	1.53	4.55	4.31	0.649	0.648	0.320	0.293	7.88	6.63
		Seaweed	1.16	1.04	1.57	1.37	1.79	1.66	4.61	4.38	0.645	0.631	0.340	0.312	8.58	7.33
		Yeast	1.17	1.06	1.58	1.38	1.82	1.69	4.64	4.42	0.643	0.625	0.342	0.314	8.65	7.34
	With	Without	1.14	1.01	1.47	1.29	1.77	1.56	4.60	4.36	0.644	0.650	0.321	0.296	8.03	6.69
		Seaweed	1.16	1.05	1.61	1.42	1.82	1.71	4.65	4.43	0.638	0.616	0.346	0.321	8.72	7.38
		Yeast	1.18	1.06	1.62	1.44	1.86	1.74	4.68	4.46	0.632	0.607	0.347	0.323	8.90	7.56
120	Without	Without	1.16	1.02	1.56	1.36	1.81	1.61	4.65	4.43	0.640	0.636	0.335	0.307	8.46	7.23
		Seaweed	1.19	1.08	1.61	1.46	1.87	1.76	4.71	4.49	0.636	0.614	0.342	0.326	9.54	8.30
		Yeast	1.20	1.09	1.64	1.47	1.89	1.78	4.73	4.51	0.635	0.610	0.347	0.327	9.73	8.50
	With	Without	1.19	1.06	1.61	1.43	1.82	1.63	4.69	4.48	0.653	0.648	0.343	0.320	8.76	7.51
		Seaweed	1.22	1.09	1.66	1.56	1.90	1.82	4.76	4.54	0.644	0.602	0.349	0.345	9.90	8.66
		Yeast	1.24	1.11	1.69	1.59	1.93	1.85	4.79	4.57	0.642	0.604	0.354	0.349	10.19	8.94
LSD at 0.05 level			NS	NS	NS	NS	NS	NS	0.22	0.37	NS	NS	NS	NS	0.51	0.25

Control * (120 kg recommended mineral nitrogen)

Leaf Pigments

Effect of chicken manure levels

Leaf pigments parameters expressed as chlorophyll (a), (b) and total chlorophyll (a+b) as well as carotenoides in leaf tissues of garlic were affected by the application of various chicken manure rates as shown in Table (9) in the two successive seasons. The highest values of chlorophyll (a), (b) and total (a+b) as well as carotenoides were recorded with the highest organic nitrogen level of 4.137 ton ChM/fed. (120 kg N/fed.) in both growing seasons. It is also cleared that non significant differences were detected between the highest chicken manure level of 4.137 ton ChM/fed. (120 kg N/fed.) and control treatment (120 kg N mineral N) on all measured parameters in both growing seasons.

Application of organic manure led to increase soil acidity, organic matter, available P, exchangeable Mn, and Zn and this in turn may affect leaf pigments Hseih and Hsu (1993). The enhancing effect due to the increase in nitrogen on photosynthetic pigments might be owe much to that N is a constituent of chlorophyll molecule. Moreover, nitrogen is the main constituent of all the amino acids. Correspondingly, an enhancement of

protein synthesis and chloroplasts formation leads to an increase in chlorophyll and carotene (Marschner, 1995). Results, are in harmony with those obtained by El-Mansi *et al*. (2004) and Bardisi *et al*.(2011) who indicated that addition of FYM at the rate of (45 m^3/ fed.) recorded maximum concentration of all leaf pigments in leaf tissues of garlic.

Effect of biofertilizers

The obtained results in Table (9) showed the effect of inoculation with triple biofertilizers on chlorophyll (a), (b) and total chlorophyll (a+b) as well as carotenoides in leaf tissues of garlic plants. It is cleared from data that inoculation with biofertilizer caused a high significant effect on all parameters in both seasons, except chlorophyll a and total chlorophyll (a+b) in the first season. Similar results are recorded by Koch *et al.* (1997) and Gouda (2008) on garlic.

Table 9 : Effect of chicken manure (ChM) levels, biofertilizers and foliar application on leaf pigments of garlic during 2008/2009 (S1) and 2009/2010 (S2) seasons

Characters / Treatments	Chlorophyll (mg/ gm DW)						Carotenoids (mg/ gm DW)	
	Chl. a		Chl. b		Total (a+b)			
	S 1	S 2	S 1	S 2	S 1	S 2	S 1	S 2
Chicken manure levels (kg N/fed.)								
Control (120 kg /fed. mineral N)	2.724	2.924	1.242	1.388	3.966	4.312	2.780	3.029
ChM at 2.068 ton/fed. (60 kg N)	2.467	2.753	1.058	1.229	3.524	3.982	2.598	2.857
ChM at 3.100 ton/fed. (90 kg N)	2.474	2.836	1.125	1.318	3.599	4.154	2.689	2.945
ChM at 4.137 ton/fed. (120 kg N)	2.682	2.929	1.208	1.405	3.890	4.334	2.764	3.025
LSD at 0.05 level	**0.149**	**0.007**	**0.001**	**0.006**	**0.187**	**0.009**	**0.008**	**0.006**
Biofertilizers								
Without	2.552	2.835	1.139	1.314	3.691	4.149	2.685	2.940
With (Az+Bac.+VAM)	2.621	2.886	1.177	1.357	3.799	4.243	2.731	2.988
F. test	**NS**	*****	*****	*****	**NS**	*****	*****	*****
Foliar applications								
Without (sprayed with tap water)	2.530	2.792	1.106	1.283	3.635	4.075	2.656	2.909
Seaweed extract	2.603	2.880	1.172	1.349	3.776	4.229	2.724	2.980
Yeast extract	2.627	2.909	1.196	1.374	3.823	4.283	2.743	3.004
LSD at 0.05 level	**NS**	**0.004**	**0.001**	**0.003**	**0.108**	**0.005**	**0.007**	**0.004**

Az: Azotabacter, Bac: Bacillus, VAM: Mycrrohiaze

Effect of foliar application

Leaf pigments of garlic plants as chlorophyll a, b and total (a+b) as well as carotenoides were significantly increased by application of yeast or seaweed extracts during the two seasons as shown in Table (9). Spraying plants with yeast extract gave the highest values of leaf pigments parameters during the two growing seasons except chlorophyll (a) in the first season, while the untreated plants gave the lowest values of all parameters in both

seasons. These results are in agreement with those of Abou El-Khair *et al.* (2010) on garlic.

Triple interaction effect

Data presented in Table (10) mentioned that there was no clear significant response in all measured parameters as affected by these interactions in the first season except chlorophyll (b), while chlorophyll (a), (b) and total (a+b) were significantly affected in the second season. Fertilization with chicken manure at the highest level of 4.137 ton/fed. (120 kg N/fed.) or mineral N (control treatment) as a fertilizer source in the presence of biofertilizer and spraying with yeast extract gave the highest values of all measured parameters. While the lowest values of all leaf pigments parameters were recorded with lowest nitrogen level as organic N (60 kg N/fed.) without biofertilizers or foliar applications in both seasons.

Table 10 : Effect of triple interaction among chicken manure levels , biofertilizers and foliar applications on leaf pigments of garlic during 2008/2009 and 2009/2010 seasons

Treatments		Characters	Chlorophyll (mg/ gm DW)						Carotenoids (mg/ gm DW)	
			Chl. a		Chl. b		Total (a+b)			
Chicken manure levels (kg N/fed.)	Biofertilizer	Foliar applications	S 1	S 2	S 1	S 2	S 1	S 2	S 1	S 2
Control *	Without	Without	2.630	2.810	1.170	1.310	3.800	4.120	2.703	2.953
		Seaweed	2.717	2.910	1.240	1.380	3.957	4.290	2.770	3.020
		Yeast	2.760	2.953	1.260	1.400	4.020	4.353	2.783	3.033
	With	Without	2.677	2.883	1.200	1.350	3.877	4.233	2.753	3.003
		Seaweed	2.770	2.980	1.280	1.430	4.050	4.410	2.823	3.063
		Yeast	2.790	3.007	1.300	1.460	4.090	4.467	2.847	3.103
60	Without	Without	2.460	2.683	0.997	1.160	3.457	3.843	2.530	2.787
		Seaweed	2.517	2.733	1.050	1.220	3.567	3.953	2.580	2.850
		Yeast	2.540	2.757	1.070	1.253	3.610	4.010	2.600	2.873
	With	Without	2.497	2.710	1.030	1.200	3.527	3.910	2.577	2.830
		Seaweed	2.550	2.803	1.090	1.260	3.640	4.063	2.640	2.890
		Yeast	2.237	2.830	1.110	1.280	3.347	4.110	2.660	2.913
90	Without	Without	2.187	2.743	1.060	1.250	3.247	3.993	2.610	2.863
		Seaweed	2.253	2.830	1.110	1.300	3.363	4.130	2.690	2.940
		Yeast	2.600	2.860	1.130	1.330	3.730	4.190	2.703	2.960
	With	Without	2.550	2.793	1.100	1.290	3.650	4.083	2.650	2.907
		Seaweed	2.617	2.880	1.160	1.360	3.777	4.240	2.730	2.987
		Yeast	2.640	2.910	1.190	1.380	3.830	4.290	2.750	3.013
120	Without	Without	2.590	2.843	1.130	1.330	3.720	4.173	2.697	2.940
		Seaweed	2.673	2.933	1.210	1.400	3.883	4.333	2.760	3.020
		Yeast	2.700	2.963	1.240	1.430	3.940	4.393	2.790	3.043
	With	Without	2.647	2.873	1.160	1.370	3.807	4.243	2.730	2.990
		Seaweed	2.730	2.970	1.240	1.440	3.970	4.410	2.800	3.067
		Yeast	2.750	2.993	1.270	1.460	4.020	4.453	2.810	3.090
LSD at 0.05 level			NS	0.012	0.002	0.009	NS	0.014	NS	NS

Control * (120 kg recommended mineral nitrogen)

REFERENCES

Abou El-Khair, E.E., I.A.S. Al-Esaily and H.E.M. Ismail . (2010). Effect of foliar spray with humic acid and green microalgae extract on growth and productivityof garlic plant grown in sandy soil. J. Product. & Dev., 15(3): 584-355.

Aisha, A.H., F. A. Rizk, A.M. Shaheen and M. M. Abdel-Mouty, (2007). Onion plant growth, bulbs yield and its physical and chemical properties as affected by organic and natural fertilization. Research Journal of Agriculture and Biological Sciences, 3(5): 380-388.

Bardisi, A., H. E.M. Ismail and D.A. S. Nawar.(2011). Growth, productivity and sulphur use efficiency of garlic plants grown in sandy soil as affected by farmyard manure and sulphur. J. Product. & Dev., 16(2):223 – 246.

Cacciari, D.L., T. Pietrosanti, and W. Pietrosanti. (1989). Phytohormones - Like substances produced by single and mixed diazotrophic cultures of *Azospirillum* and *Arthrobacter .* Plant and Soil 115 :151-153.

El-Ghamriny, E.A., H.M.Arisha and K.A. Nour. (1999). Studies on tomato flowering, fruit set , yield and quality in summer season.1. spraying with thiamine , ascorbic acid and yeast . Zagazig J. Agric. Res., 26 (5): 1345-1364.

El-Hifny I. M. (2010). Response of garlic (*Allium sativum* L.) to some sources of organic fertilizers under north Sinai conditions. Res. J. Agric. and Biol. Sci. 6(6): 928-936,

El-Mansi, A.A., A. Bardisi, A. N. Fayad, and E. E. Abou- El-Khair. 2004. Effect of water quantity and farmyard manure on garlic under sandy soil conditions. 1. Dry weight and plant chemical composition. Zagazig . J. Agric. Res. 31 (2) :253-277.

El-Morsy, A.H.A., A.M. Moghazy and U.M. Saif El-Deen. (2009) Effect of certain NP-rates and application methods of biofertilizers (microbein) on productivity and storability of garlic. J. Agric. Sic. Mansoura Univ., 34(5): 5053-5065.

El-Morsy, A.H.A., U.M. Saif El-Deen and A.S. Ezzat. (2011). Response of growth , productivity and storability of garlic (*Allium sativum* L.) to foliar spray with magnesium and yeast extract. J. Plant production, Mansoura Univ., 2(1): 39-51.

El-Seifi, S. K., Sawsan, M.H. Sarg, A. I. Abdel-Fattah and M.A. Mohamed. (2004). Effect of biofertilizers and nitrogen levels on the productivity and quality of Chinese garlic under sandy soil conditions. Zagazig J. Agric. Res. 31(3):889-914.

El-Shabasi, M.S.S., S. A. Gaafar and F. A. Zahran. (2003). Efficiency of biofertilizer nitrobein under different levels of inorganic nitrogen fertilizer on growth , yield and its chemical constituents of garlic plants. J. Agric. Sci. Mansoura Univ. 28 (9) 6927-6938.

Fathy, E.S.L. and S. Farid, (1996). The possibility of using vitamin Bs and yeast to delay senescence and improve growth and yield of common beans (*Phaseolus vulgaris*. L.) J. Agric. Sci. Mansoura Univ. 21(4): 1415-1423.

Gomez, K.A. and R.Gomez (1984). Statistical Procedure for Agric. Res. 2nd Ed. John Willey and Sons. Inc. New York, 680 pages.

Gouda, A. E.A. (2008). Effect of some nitrogenous and phosphatic fertilizers sources and VA- Mycorrhizae inoculum on growth, productivity and storability of garlic (*Allium sativum* L.). Ph. D. Thesis, Fac. Agric. Mansoura Univ. Egypt.

Hassan, A. H. (2005). Growth and production of garlic plant (*Allium sativum* L.) as influenced by nitrogen fertilizer in the form of organic and inorganic. The 6th Arabian Conference For Horticulture, Ismailia, Egypt.

Hseih, C. F., and K. N. Hsu (1993). An experiment on the organic farming of sweet corn and vegetable soybeans. Bulletin of Taichung District Agricultural Improvement Station, 39:29-39.

Kader, A.A. , K.Abdullahzai, M. Saleem and S.A. Qaim Shah.(2002). Effect of nitrogenous fertilizer on growth and yield of garlic. Asian J. Plant Sci. 1(5): 544-545.

Koch, M., Z.Tanami, H.Bodani, S.Wininger and Y.Kapulinik (1997). Field application of vesicular arabuscular mycorrhizal fungi improved garlic yield in disinfected soil. Mycorrhizae, 7 (12):47-50. (CF. CAB Abstr.)

Koller, H.R.C. (1972). Leaf area and leaf weight relationship in the soybean. Canopy Crop Sci. 12: 180-183.

Mahesh B., D. Mayura and P.K. Jite. (2009). Role of bioinoculant (AM fungi) increasing in growth, flavor content and yield in garlic (*Allium sativum* L.) under field condition. Notulae Botanicae, Horti Agrobotanici, Cluj-Napoca. 37: (2): 124-128.

Mann, L. K. (1952). Anatomy of garlic bulb and factors affecting bulb development. Hilgardia 21:195-231.

Marschner, H. (1995). Mineral Nutrition of Higher Plants. 2nd (ed.), Academic Press Limeted , Text Book.

Midan, S. A. (2007). Mineral phosphates, mycorrhizae and phosphate solubilizing bacteria in relation to garlic plant behavior. J. Agric. Sci. Mansoura Univ., 32 (4):2725-2746.

Mohsen, A.A.M., A.A.A. El-Mansi, M.A.I. Khalil and H.M.E. Arisha. (2011). Influence of mycorrhizal and mineral phosphorus application on growth, yield and quality of garlic plants grown in sandy soil . Egypt . J. Appl. Sci. 26 (10) : 269-280

Ortas, I. (2008). The effect of mycorrhizal inoculation on forage and non-forage plant growth and nutrient uptake under field conditions. Options Mediterraneennes. Series A, 79: 463-469.

Paleg, L.G. (1985). Physiological effects of gibberellins. Ann. Rev. Plant Physiol . 16 : 291-322.

Shashidhar, T. R., I. M. Mannikeri, M. L. Chavan. (2009). Influence of different organic manures on growth and yield of garlic (*Allium sativum*). Journal of Ecobiology, 25 (3): 235-239.

Snedecor, G. W. and W. G. Cochran. (1980). Statistical methods. 7th ed. Iowa State Univ. Press, Ames, Iowa, U.S.A., PP. 507.

Spinelli, F., F.Giovanni, N. Massimo, S. Mattia, and C. Guglielmo (2009). Prospectives on the use of a seaweed extract to moderate the negative effects of alternate bearing in apple trees. J. Hort. Sci. Biotechnol., 17(1): 131-137.

Subba Rao, N.S. (1993).Biofertilizers in agriculture 3 rd (ed.), Oxford, BH Publishing Co. Lit.,New Delhi , Bomby, Calcutta ,219 pp.

Suthar, S. (2009). Impact of vermicompost and composted farmyard manure on growth and yield of garlic (*Allium stivum* L.). Field crop International Journal of Plant Production 3 (1): 27-39.

Warade, S D., S B. Desale, and K G. Shinde. (1996). Effects of organic, inorganic and biofertilizers on yield of onion bulbs cv. B 780. J. Maharashtra Agric. Univ., 20(3) : 467 468.

Wettestein, D. (1957). Chlorophyll. Lethale under Submikross – Kopische Formwechesl der Plastiden. Exptl. Cell. Res. 12 : 427-433.

تأثير مستويات سماد الدواجن والأسمدة الحيوية وبعض معاملات الرش على الثوم 1. نمو النبات ومحتوى الأوراق من الصبغات

كوثر كامل ضوه*، البسيونى احمد عبد الواحد رضوان و فوزى يحيى عمر منصور****

*** قسم الخضر والزينة- كلية الزراعة- جامعة المنصورة - مصر**

**** قسم بحوث البطاطس والخضر خضرية التكاثر- معهد بحوث البساتين- مركز البحوث الزراعية – مصر**

أجريت هذه الدراسة خلال موسمى شتاء 2008/2009 ، 2009/2010 بمحطة الجميزة للبحوث الزراعية- مركز البحوث الزراعية ، وذلك لدراسة تأثير مستويات سماد الدواجن والتسميد الحيوى وبعض معاملات الرش والتفاعل بينهما على النمو ومحتوى الأوراق من الصبغات للثوم سلالة سدس 40 . **ويمكن تلخيص أهم النتائج المتحصل عليها كالتالى:-**

1. أعطت معاملة تسميد نباتات الثوم بالنتروجين بمعدل 120 كجم نيتروجين /فدان فى صورة (نتروجين معدنى) وكذلك فى صورة سماد الدواجن (4.137 طن/فدان) أعلى القيم لصفات النمو الخضرى مثل طول النبات، عدد الأوراق / النبات ، الوزن الطازج والجاف للنبات ، قطر كل من العنق و البصلة عند 105 و 135 يوم بعد الزراعة والوزن الجاف للبصلة عند 135 يوم بعد الزراعة ، وكذلك محتوى الأوراق من كلوروفيل أ، ب ، والكلورفيل الكلى والكاروتينويدات فى كلا الموسمين.
2. أدى تلقيح فصوص الثوم بالسماد الحيوى الى زيادة معنوية فى كل قياسات النمو وكذلك محتوى الأوراق من الصبغات مقارنة بالنباتات غير المعاملة بالسماد الحيوى فى كلا الموسمين.
3. أدت معاملة الرش بمستخلص الخميرة الى زيادة معنوية فى طول النبات، عدد الأوراق / النبات ، الوزن الطازج والجاف للنبات ، قطر كل من العنق و البصلة والوزن الجاف للبصلة عند135 يوم بعد الزراعة ، وكذلك محتوى الأوراق من كلوروفيل أ، ب ، والكلورفيل الكلى والكاروتين ويدات فى كلا الموسمين يليها الرش بمستخلص الطحالب البحرية فى كلا الموسمين.
4. كانت أفضل النتائج لتحسين صفات النمو الخضرى وذلك بتسميد نباتات الثوم بمعدل 120 كجم ن/فدان من سماد الدواجن (4.137 طن/فدان) أو من السماد المعدنى مع وجود السماد الحيوى و الرش بمستخلص الخميرة حيث يمكن أن نوصى بها تحت نفس ظروف التجربة .

قام بتحكيم البحث

أ.د / محمود محمد زغلول	**كلية الزراعة – جامعة المنصورة**
أ.د / عبد الله برديسي احمد	**كلية الزراعة – جامعة الزقازيق**