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EFFECT OF ORGANIC, BIO AND MINERAL FERTILIZATION ON YIELD AND QUALITY OF CARROT PLANTS

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ABSTRACT

Two field experiments were conducted during the two successive winter seasons of 2009/2010 and 2010/2011 in a private Farm in Bani-Ebeed District, Dakahlia Governorate. The aim is to study the effect of organic, bio, mineral fertilization and their interactions on yield and quality of carrot cv. shantenay.

In general, it can be concluded that:

1- Fertilizing with compost gave the highest values of yield and quality of carrot comparing with untreated plants in both studied seasons.
2- Bio-fertilizing significantly increased yield and quality and the superiority was to the plants treated with bio-fertilizer mixture (*Azotobacter, Bacillus circulans, Mycorrhiza)* followed by EM.
3- Fertilizing with 100% NPK has achieved the highest values of yield however, 75% NPK gave the highest values of carrot quality.
4- The interaction among compost, bio-fertilizer (mixture or EM) and 100% NPK gave the highest values of yield however, compost plus bio fertilizer (Mixture or EM) and 75% NPK gave the superiority for yield and quality comparing with plants fertilizing with 100% NPK alone.

Keywords: *carrot, daucus carota* L., organic fertilizer, compost, bio-fertilizer, mineral fertilizer, *Azotobacter, Bacillus circulans, Mycorrhiza,* EM, yield, quality.

INTRODUCTION

Carrot (*Daucus carota* L.) is a member of family Apiaceae and considers as popular vegetable crops, and one of the main vegetable crops in Egypt. The fleshy roots are eaten as raw in salads, boiled or steamed in vegetable dishes and also used with other vegetables in the preparation of soap, baby foods, as well as, its use in industries to produce juice and jam. In addition, it also has a medical value, it is rich in carotenes content the source of vitamin A. The cultivated area of carrot in Egypt reached 13,651 fed. in 2010 and the total production was 175,923 tons, according to the Ministry of Agriculture Statistics.

There is a great need for further studies under Egyptian conditions to establish recommendation for reducing the amount of chemical NPK fertilizers for improving the quality and limiting the environment of pollution. It has focused the light on the use of untraditional fertilizer especially the organic (compost) and bio-fertilizers.

However, it is essential to adopt a system of organic fertilizer in vegetables due to increasing the objectives against the chemical farming as a main source of soil and water pollution as well as food products.

Bio-fertilizers are microbial preparations containing, primary beneficial role in famishing a proper rhizosphere for plant growth thus, it cause minerals

solubilizing and facilitate minerals (especially N) uptake (Abou-Hussein *et al.*, 2002).

A mixture of microorganisms,i.e., (*Azotobacter chroococcum* bacteria, which fix nitrogen; *Bacillus circulans* bacteria, which make potassium more available and *Mycorrhiza* fungi, which increases phosphorus availability was used to improve yield and quality of many vegetative crops such as, lettuce (Hanafy Ahmed *et al.*, 2000), potato (Kushwah and Banafar, 2003) , pepper (Dawa *et al.*, 2012) and garlic (Dawa *et al.*, 2012).

EM is an abbreviation for effective microorganisms and refers to a mixture of beneficial microorganisms that is used as a soil amendment (Woodward, 2003). EM contains selected species of microorganisms, including predominant populations of lactic acid bacteria, yeasts, smaller numbers of photosynthetic bacteria, actinomycetes and other types of organisms. All of these play beneficial roles in roots rheizosphere which improve vegetative growth, yield and quality of plants such as potato (Abou-Bakr *et al.*, 2005) and onion (Abdel Naby *et al.*, 2012).

The present investigation aimed to study the effect of organic, bio and mineral fertilization on growth, yield and quality of carrot. Also to study to what extent the organic and bio-fertilizer can replace some of the recommended NPK (mineral fertilizers).

MATERIALS AND METHODS

Two field experiments were conducted in a private farm at Bani-Ebad near deckernis cinter, Dakahlia Governorate during two successive winter seasons of 2009/2010 and 2010/2011 to investigate the effect of mineral, organic, bio-fertilization and their interaction on yield and quality of carrot (***Daucus carota* L.)** cv. shantenay.

Seeds of Shantenay cultivar were sown at the rate of 2.5 kg /fed in plots 3m long and 70 cm wide. Experimental units was 2.1 m^2. Sowing dates were on 30 and 20 October for the first and second seasons; respectively.

Mechanical and chemical analysis of soil:

Soil samples were taken at random from the experimental field area at a depth of 0 – 30 cm from soil surface before sowing to estimate the mechanical and chemical soil properties as shown in Table 1.

The experimental design and treatments

The experiments of study were executed in a strip split plot design with three replicates. Each experiment included 18 treatments comprising, two organic fertilization (compost); three bio-fertilization and three mineral fertilizer levels.

- The vertical plots were assigned to two organic fertilization (compost) treatments as follows:

1-Without compost.

2-With compost (4ton/fed).

- The Horizontal plots were devoted to three bio-fertilizers as follows;

1-Without bio-fertilization.

2-Bio-fertilizer mixture was applied to the soil at the rate of 20 L/fed.

3-Effective Microorganisms (EM) was added to the soil at rate of 2 ml/1L.

- The sub-plots were located to three mineral fertilization levels as follows:

1-100 % of NPK fertilizers as recommended by the Ministry of Agric. and soil Recl. (MASR) for carrot plant (60 kg N+40 kg P_2O_5+62 kg K_2O per fed.)
2-75 % NPK.
3-50 % NPK.

Each treatment was replicated three times; thus, the total numbers of the experimental plots were 54 plots.

Table 1: Physical and chemical analysis of the experimental soil during 2009/2010 and 2010/2011 seasons.

Soil properties	2009-2010	2010-2011
Sp%	58	56
PH*	8.17	8.05
EC** dS^{-1}	0.87	0.93
Mechanical analysis%:		
Coarse sand%	2.7	1.9
Fine Sand%	17.5	19.2
Silt%	32.9	33.1
Clay%	46.9	45.8
Texture class	Clayey	Clayey
Organic matter%	1.92	1.97
Available (ppm):		
N	46	49
P	5.78	5.12
K	325	342
Fe	12.3	13.5
Mn	7.6	8.1
Zn	3.2	2.9
Ions meq/100g soil		
Ca^{++}	1.12	0.98
Mg^{++}	0.85	0.72
Na^{+}	3.41	2.98
K^{+}	0.07	0.08
CO_3^{--}	0.00	0.00
HCO_3^{-}	1.80	1.86
Cl^{-}	2.12	2.33
$SO4^{--}$	1.47	0.57

*Soil suspension (1:2.5) ** Soil extraction (1:5)

Organic fertilizer

Compost was mixed with the surface layer of the soil during soil preparation before seed sowing, at the rate of 4 ton/ fed. Some chemical properties of used compost were presented in Table 2.

Bio-fertilizer

Bio-fertilizer mixture (*Azotobacter chroococcum* bacteria, which fix nitrogen; *Bacillus circulanc* bacteria, which make potassium more available and *Mycorrhiza* fungi, which increases phosphorus avilability) was kindly provided from the unit of bio-fertilizers, Fac. of Agric., Ain shams Univ., Cairo, Egypt. The mixture was added to the soil after 6 and 8 weeks from seed sowing at the rate of 20 L/fed.

Effective Microorganisms (EM) was obtained from Ministry of Agriculture laboratories Cairo, Egypt. EM was applied to soil at the rate of 2 ml/L water, twice., after 6 and 8 weeks from seed sowing.

Table 2: Some chemical properties of compost during both seasons of 2009/2010 and 2010/2011:

Compost properties	2009-2010	2010-2011
Sp%	230	218
PH(1:5)	6.13	6.18
EC(1:10)dS^{-1}	4.68	4.49
Organic matter%	37.2	37.7
C%	21.6	21.9
N%	1.14	1.23
C/N	19.0	17.8
P%	0.23	0.27
K%	0.44	0.51
Total (ppm):		
Fe	136	141
Mn	87.5	79.2
Zn	9.7	7.2

Mineral fertilizer

Ammonium nitrate (33.5 % N), Ca-super phosphate (15.5 % P_2O_5) and potassium sulphate (48 % K_2O) were the respective sources of N, P and K. Three treatments of N, P and K fertilizers at the rates of 50, 75 and 100 % from the recommended doses for carrot plants, i.e., 60, 40 and 62 $kg.fed^{-1}$ for N, P and K, respectively were used. Treatments of N, P and K fertilizers were divided into two equal doses and applied after 6 and 10 weeks from seed sowing.

Sampling

A. Yield:

At harvesting stage; 160 days after sowing, Total roots yield (ton/fed) was estimated.

Nine roots from each treatment were taken at 120 and 160 days after sowing and following data were recorded:

B. Quality parameters of roots:

1. **Total carotene**. It was estimated using a method described by Dubois *et al.*, (1956).
2. Nitrate content. It was measured by a spectrophotometer according to the method described by Singh (1988).
3. Total soluble sugar was determined according to the method described by Sadasivam and Manickam (1996).
4. Non-reducing sugar (%)was determined according to the method described by Naguib (1964).

Statistical analysis

All data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the strip split – plot design as published by Gomez and Gomez (1984) by means of "MSTAT-C" Computer software package. The treatment means were compared using least significant

difference (LSD) method at 5 % levels of probability according to the procedure outlined by Snedcor and Cochran (1980).

RESULTS AND DISCUSSION

1. Yield of carrot plant.

Results in Tables 3 and 4 describe the effect of organic, bio, mineral fertilization and their interactions on yield of carrot plants after 160 days from sowing date in both seasons.

Effect of organic fertilizer:

Results in Table 3 indicate that yield of carrot were significantly increased by fertilization with compost as compared with control treatments after 160 days from sowing date in both seasons., since it recorded 20.61 and 22.56 ton/fed. compared to 18.32 and 20.34 ton/fed. for the control in the first and second seasons, respectively.

Table 3: Total yield of carrot roots at 160 days from sowing as affected by organic, bio and mineral fertilization as well as their interactions during 2010 and 2011 seasons.

Characters / Treatments	Total yield of roots (ton/fed)	
	2010	2011
A- Organic fertilization:		
Without	18.32	20.34
Compost	20.61	22.56
F. test	*	*
B-Bio fertilization:		
Without	18.34	19.92
Mixture	20.23	22.48
EM	19.84	22.01
LSD at 5 %	0.85	0.88
C- Mineral fertilization:		
100 %	21.50	23.18
75 %	18.91	21.60
50 %	18.00	19.58
LSD at 5 %	0.96	0.76
D- Interactions:		
A X B	*	*
A X C	*	*
B X C	*	*
A X B X C	*	*

Effect of bio-fertilizer:

As for the effect of bio-fertilizer treatments, data in the same Table reveal that both bio-fertilization treatments significantly increased yield of carrot plants compared with untreated plants. On other words, soil treated with bio-fertilizer mixture was superior for increasing yield of carrot plants.

Effect of mineral fertilizer:

Referring the effect of mineral fertilization, data in Table 3 reflect that yield of carrot plants was significantly decreased with decreasing the level of NPK less than the recommended dose. This reduction in the yield rate was

more pronounced under 50% NPK from the recommended dose. The highest values of carrot roots yield were recorded from the plants fertilized with 100% NPK in both seasons.

Effect of interaction:

The interaction effects among all studied factors (A×B), (A×C), (B×C) and (A×B×C) on yield of carrot root, in Table 3 indicate that all interactions gave significant effects in both seasons.

Data presented in Table 4 show significant effects of the triple interaction among organic, bio and mineral fertilization. The highest values were recorded when plants treated with compost plus bio-fertilizer mixture and 100%NPK followed by plants treated with compost plus EM and 100%NPK without significant differences. While the lowest values were recorded when plants treated with 75% or 50% NPK alone in both seasons.

Table 4: Total yield of carrot roots as affected by the interaction among organic, bio and mineral fertilization during 2010 and 2011 seasons.

Treatments			Total yield of roots (ton/fed)	
			2010	2011
Without	Without	100 %	18.71	19.87
		75 %	16.80	18.10
		50 %	16.88	18.45
	Mixture	100 %	22.08	23.05
		75 %	17.99	21.46
		50 %	17.37	19.38
	EM	100 %	20.30	22.61
		75 %	17.54	21.37
		50 %	17.22	18.38
Compost	Without	100 %	21.34	21.78
		75 %	18.20	20.98
		50 %	18.11	20.38
	Mixture	100 %	23.63	26.39
		75 %	21.35	23.90
		50 %	18.94	20.40
	EM	100 %	22.93	25.44
		75 %	21.59	23.78
		50 %	19.46	20.00
LSD at 5 %			1.75	1.38

2. Quality parameters of carrot roots.

The parameters used for measuring quality characters in this study are total carotene, nitrate, total soluble sugars and non-reducing sugars in the roots of carrot.

2.1- Total carotene and nitrate in carrot roots.

Results in Tables 5 and 6 describe the effect of organic, bio, mineral fertilization and their interactions on total carotene and nitrate in carrot roots at 120 and 160 days from sowing date in both seasons.

Effect of organic fertilizer:

Results in Table 5 show that adding compost in both seasons of the study significantly increased the average values of total carotene and

significantly decreased nitrate in roots of carrot at 120 and 160 days from sowing than those obtained from untreated plants.

Effect of bio-fertilizer:

As for the effect of bio-fertilizer treatments, data in Table 5 reveal that application of bio-fertilizer mixture or EM significantly increased the mean values of total carotene and significantly decreased the mean values of nitrate in carrot roots at 120 and 160 days from sowing comparing with untreated plants during both seasons.

Effect of mineral fertilizer:

Referring the effect of mineral fertilization, data in Table 5 indicate that the highest values of total carotene were obtained when plants fertilized with 75% NPK following by 100% NPK except at 120 days from sowing in the second season, the highest value were obtained when

Table 5: Total carotene and nitrate in carrot roots at 120 and 160 days from sowing (DFS) as affected by organic, bio and mineral fertilization as well as their interactions during 2010 and 2011 seasons.

Characters / Treatments	Total carotene in root (mg/100g)				Nitrate content in root (ppm)			
	2010		2011		2010		2011	
	120 DFS	160 DFS	120 DFS	160 DFS	120 DFS	160 DFS	120 DFS	160 DFS
A- Organic fertilization:								
Without	8.37	8.76	8.59	8.53	45.67	42.93	44.32	37.67
Compost	8.65	9.07	8.98	8.86	45.07	42.37	43.93	36.82
F. test	*	*	*	*	*	*	*	*
B-Bio-fertilization:								
Without	8.27	8.67	8.62	8.42	46.92	44.16	45.90	38.40
Mixture	8.65	9.06	8.81	8.90	44.28	41.60	44.28	37.88
EM	8.60	9.03	8.93	8.77	44.91	42.20	42.20	35.46
LSD at 5%	0.03	0.03	0.06	0.07	0.10	0.07	0.43	0.54
C- Mineral fertlization:								
100 %	8.67	9.08	8.97	8.86	46.97	44.16	44.89	38.44
75 %	8.72	9.13	8.93	8.92	45.30	42.58	44.00	36.83
50 %	8.13	8.54	8.45	8.30	43.84	41.21	43.49	36.47
LSD at 5%	0.02	0.03	0.05	0.06	0.03	0.02	0.26	0.31
D- Interactions:								
A X B	*	*	*	NS	NS	NS	*	*
A X C	*	*	*	NS	*	*	NS	*
B X C	*	*	*	*	*	*	*	*
A X B XC	*	*	*	NS	NS	NS	*	*

plants fertilized with 100% NPK and the differences between 75% and 100% NPK did not reach to the level of significance during second season. Meanwhile, data indicated that; more nitrate was accumulated in carrot roots due to increasing the rate of NPK-addition from 50% to 75 % NPK and recorded the highest values at the level of 100 %NPK during both seasons.

Effect of interactions:

From Table 5 it is clear that the interaction (A×B) gave significant effects for total carotene and nitrate in carrot roots in both seasons except total carotene at 160 days from sowing in the second season and total nitrate at 120 and 160 days from sowing in the first season.

The interaction between (A×C) in the same Table gave significant effects for total carotene and nitrate in carrot roots in both seasons except total carotene and total nitrate at 160 and 120days from sowing in the second season, respectively.

The interaction between (B×C) also gave significant effects for total carotene and nitrate in carrot roots at 120 and 160 days from sowing in both seasons.

Table 5 shows that the impact of triple interaction (A×B×C) gave significant effects on total carotene and nitrate in carrot roots at 120 and 160 days from sowing except total carotene at 160 days from sowing in the second season and nitrate at 120 and 160 days from sowing in the first season.

Data in Table 6 show that the highest mean values of total carotene were connected with the treatment of compost plus EM and 75 % NPK followed by application of compost plus Mixture and 75 % NPK in both seasons. While, the highest mean values of nitrate were connected with the treatment of 100 % NPK alone at 120 and 160 days from sowing in the second season.

2.2- Total soluble sugars and non-reducing sugars in carrot roots.

Results in Tables 7 and 8 describe the effect of organic, bio, mineral fertilization and their interactions on total soluble sugars and non-reducing sugars in roots of carrot at 120 and 160 days from sowing date in both seasons of the study.

Effect of organic fertilizer:

Results in Table 7 show that application of compost in both seasons of the experiment significantly increased the average values of total soluble sugars and non-reducing sugars in carrot roots at 120 and 160 days from sowing than the untreated plants.

Effect of bio-fertilizer:

As for the effect of bio-fertilizer treatments, data in Table 7 indicate that bio-fertilizer mixture or EM significantly increased the mean values of total soluble sugars and non-reducing sugars in carrot roots at 120 and 160 days from sowing comparing with the untreated plants during both seasons.

The highest values were recorded for plants treated with bio-fertilizer mixture followed by plants treated with EM and the lowest values obtained with the untreated plants in both seasons except non-reducing sugars at 120 days from sowing in the second season.

Effect of mineral fertilizer:

Concerning the effect of mineral fertilization, data in Table 7 reflect that the highest values of total soluble sugars and non-reducing sugars in roots of carrot at 120 and 160 days from sowing were obtained when plants fertilized with 75% NPK followed by 100% NPK and the differences were significant during both seasons while, the lowest values of these parameters were recorded when plants were fertilized with 50% NPK from recommended dose.

Table 6: Total carotene and nitrate content in carrot roots at 120 and 160 days from sowing (DFS) as affected by the interaction among organic, bio and mineral fertilization during 2010 and 2011 seasons.

Treatments			Total carotene in root (mg/100g)				Nitrate content in root (ppm)			
			2010		2011		2010		2011	
			120 DFS	160 DFS	120 DFS	160 DFS	120 DFS	160 DFS	120 DFS	160 DFS
Without	Without	100 %	8.58	9.00	8.88	8.69	48.74	45.88	46.53	39.10
		75 %	8.13	8.49	8.46	8.30	46.94	44.14	45.90	38.20
		50 %	7.83	8.22	8.13	7.94	46.04	43.31	45.46	38.06
	Mixture	100%	8.54	8.92	8.91	8.74	46.29	43.51	46.29	43.51
		75 %	8.89	9.36	8.37	9.20	44.59	41.88	44.20	37.16
		50 %	8.23	8.61	8.51	8.36	42.84	40.21	43.80	36.63
	EM	100%	8.44	8.79	8.82	8.57	46.82	44.01	42.76	35.90
		75 %	8.59	8.98	8.86	8.82	45.03	42.33	42.30	35.30
		50 %	8.09	8.49	8.41	8.20	43.72	41.12	41.70	35.20
Compost	Without	100%	8.88	9.33	9.32	9.01	48.10	45.27	46.52	38.90
		75 %	8.32	8.66	8.68	8.48	46.44	43.72	45.56	38.33
		50 %	7.90	8.31	8.24	8.10	45.25	42.64	45.40	37.80
	Mixture	100%	8.77	9.16	8.77	9.16	45.68	42.95	44.50	37.23
		75 %	9.16	9.57	9.62	9.37	44.16	41.49	43.63	36.70
		50 %	8.33	8.74	8.68	8.57	42.13	39.54	43.26	36.06
	EM	100%	8.82	9.27	9.14	9.02	46.17	43.38	42.70	36.00
		75 %	9.24	9.76	9.63	9.37	44.67	41.96	42.40	35.30
		50 %	8.44	8.88	8.75	8.64	43.06	40.43	41.33	35.10
LSD at 5 %			0.06	0.07	0.13	NS	NS	NS	0.60	0.75

Table 7: Total soluble sugars and non-reducing sugars percentages in carrot roots at 120 and 160 days from sowing (DFS) as affected by organic, bio and mineral fertilization as well as their interactions during 2010 and 2011 seasons.

Characters / Treatments	Total soluble sugars (%)				Non-reducing sugars (%)			
	2010		2011		2010		2011	
	120 DFS	160 DFS	120 DFS	160 DFS	120 DFS	160 DFS	120 DFS	160 DFS
A- Organic fertilization:								
Without	14.47	14.17	14.59	13.91	9.45	9.22	10.12	9.36
Compost	15.01	14.70	15.09	14.38	9.74	9.50	10.38	9.58
F. test	*	*	*	*	*	*	*	*
B-Bio-fertilization:								
Without	14.34	14.01	14.42	13.70	9.28	9.03	10.00	9.20
Mixture	14.98	14.68	15.09	14.44	9.80	9.57	10.35	9.68
EM	14.91	14.61	15.02	14.29	9.70	9.48	10.41	9.53
LSD at 5%	0.02	0.05	0.08	0.09	0.06	0.04	0.06	0.05
C- Mineral fertilization:								
100 %	15.03	14.71	15.10	14.40	9.76	9.55	10.38	9.67
75 %	15.12	14.81	15.21	14.45	9.87	9.58	10.53	9.76
50 %	14.08	13.78	14.21	13.57	9.15	8.94	9.84	8.99
LSD at 5%	0.03	0.03	0.05	0.08	0.03	0.03	0.05	0.06
D- Interactions:								
A X B	*	*	*	*	*	*	*	*
A X C	*	*	*	*	*	*	*	*
B X C	*	*	*	*	*	*	*	*
A X B X C	*	*	*	*	*	*	*	*

Table 8: Total soluble sugars and Non-reducing sugars percentages in carrot roots at 120 and 160 days from sowing (DFS) as affected by the interaction among organic, bio and mineral fertilization during 2010 and 2011 seasons.

Treatments			Total soluble sugars (%)				Non-reducing sugars (%)			
			2010		2011		2010		2011	
			120 DFS	160 DFS	120 DFS	160 DFS	120 DFS	160 DFS	120 DFS	160 DFS
Without	Without	100 %	14.89	14.56	14.95	14.16	9.54	9.33	10.27	9.50
		75 %	14.05	13.73	14.12	13.36	9.16	8.87	9.81	9.09
		50 %	13.50	13.20	13.58	13.09	8.73	8.47	9.44	8.71
	Mixture	100%	14.74	14.44	14.87	14.22	9.65	9.50	10.36	9.63
		75 %	15.43	15.18	15.60	14.82	10.32	9.91	10.77	9.98
		50 %	14.21	13.93	14.38	13.66	9.30	9.06	9.96	9.21
	EM	100%	14.62	14.33	14.73	14.05	9.53	9.37	10.23	9.48
		75 %	14.85	14.59	14.99	14.31	9.67	9.53	10.41	9.64
		50 %	13.93	13.62	14.14	13.50	9.12	8.93	9.84	9.03
Compost	Without	100%	15.40	15.12	15.41	14.55	9.96	9.74	10.80	9.86
		75 %	14.46	14.08	14.54	13.86	9.41	9.11	10.07	9.30
		50 %	13.72	13.41	13.91	13.17	8.86	8.68	9.61	8.76
	Mixture	100%	15.20	14.84	15.20	14.84	9.92	9.69	9.92	9.69
		75 %	15.86	15.57	15.92	15.12	10.23	10.02	11.01	10.27
		50 %	14.44	14.14	14.55	14.00	9.40	9.23	10.06	9.34
	EM	100%	15.32	15.01	15.45	14.61	9.98	9.69	10.72	9.86
		75 %	16.07	15.74	16.10	15.24	10.43	10.08	11.12	10.27
		50 %	14.67	14.40	14.73	14.01	9.49	9.31	10.15	8.90
LSD at 5 %			0.07	0.08	0.12	0.19	0.06	0.07	0.12	0.13

Effect of interactions:

From Table 7 it is clear that all interactions among all studied factors (A×B), (A×C), (B×C) and (A×B×C) on total soluble sugars and non-reducing sugars of carrot root, gave significant effects during both seasons.

Data in Table 8 show that the highest mean values of the previously mentioned traits were connected with the application of compost plus EM and 75 % NPK followed by the treatments of compost plus bio-fertilizer mixture and 75 % NPK and the lowest values were connected with the application of 50 % NPK alone at 120 and 160 days from sowing during both seasons.

The previously mentioned results can be discussed as follow:

Obtained results can be discussed by clarifying the direct and indirect effects of used treatments on yield and its component of carrot roots as follows:

Effect of compost fertilization:

Our results can be attributed to the positive impacts of compost on physical and chemical properties of soil, where organic matter improved soil drainage, ventilation and increased the soil ability to water retain. It is known that compost is used as a soil amendment which improves holding capacity of soils and increases availability of elements such as boron (Aggelides and Londra, 2000). Due to all these positive effects of compost on yield and its components of carrot were significantly improved. Our findings are in agreement with those obtained by Zahoor *et al.* (2005) on carrot, Mahmoud

et al. (2009) on cucumber, Shehata *et al.* (2011) on strawberry and Dawa *et al.* (2012) on pepper.

Effect of bio-fertilizers:

Bio-fertilizer mixture contains: *Azotobacter, Bacillus circulans and Mycorrhiza.* While the basic groups of microorganisms in EM are lactic acid bacteria, yeast and phototrophic bacteria.

Azotobacter fixes the atmospheric nitrogen and benefits the crop. While *Mycorrhiza* fungi are directly involved in plant mineral nutrition. It increases the uptake of less mobile nutrients, especially phosphorus and micronutrients like zinc and copper and also it has appositive impact on water uptake (Ortas *et al.*, 2001).

As for *Bacillus circulanc* it is important for potassium solubilization and other mineral nutrients. The roles played by the aforementioned microorganisms are caused the superiority of mixture treatment over other treatments in majority of yield and quality of carrot roots parameters.

EM consists of Lactic acid bacteria, Yeasts, Actinomycetes and Photosynthetic bacteria **(Xu 2000).**The positive impacts of EM may be due to its components of these microorganisms and its performance on enhancing growth and yield of carrot plants.

The obtained results show superiority of bio-fertilizer treatments over control treatment in improving carrot yield and its components.Wherein the bio-fertilizer mixture treatment often occupied the first order followed by EM. Both treatments contain many different types of microorganisms, the positive impact that happened on the yield and its components may be due to the effect of these organisms on growth and yield whether directly or indirectly.

Our findings are in agreement with those obtained by Higa and Parr (1994), Ashwini kumar *et al.* (2007) and Merghany *et al.* (2008) on carrot, Abdel Naby *et al.* (2012) on onion and Dawa *et al.* (2012) on pepper.

Effect of NPK

We can attribute these results, to the direct and indirect influences of NPK nutrients on vegetative growth parameters of carrot which reflected on improvement of yield and quality.

The highest addition of NPK gave the highest values of yield the obtained results may be due to the positive effects of N, P and K elements on plant growth and translocation of carbohydrates from the leaves to carrot roots which reflected on yield and quality. Our findings are in agreement with those obtained by Ashwini kumar *et al.*, (2007) on carrot and Okonwu and Mensah (2012) on pumpkin.

The interaction among compost plus bio-fertilizer mixture and 100% NPK and compost plus EM and 100%NPK which gave the highest values of aforementioned parameters, these results can be attribute to the positive collection effects of organic, bio and mineral fertilization on vegetative growth and yield of carrot plants. These results are in the same line with those obtained by Bruno *et al.* 2007 on carrot, Lindani and Brutsch (2012) on tomato and Khan *et al.*, (2012) on pepper.

Concerning the effect of the treatments on quality parameters:

Carotene contents in carrot roots often raised under the beneficial influences of compost, microorganisms and the highest levels of mineral

fertilization. These results may be due to the improvement of photothensis as a result of the positive effects of materials used on vegetative growth of carrot. These results are in harmony with Merghany *et al.* (2008) who found that compost application significant increase carotene content on carrot roots. Nitrate contents in carrot roots were the highest in control treatments comparing with organic and bio-fertilization treatments. This impact may be due to absence of microorganism activities in the roots rheizospher whether with compost or bio-fertilizer treatments, which caused nitrate accumulation in the media and roots. These results are in harmony with Hanafy Ahmed *et al.* (2000) who found significant decrease in nitrate accumulation in lettuce plants treated with all studied bio-fertilizers.

Total soluble sugars and non-reducing sugars percentages, probably the reasons affected carrot plants growth and yield, influenced also the previous characters.

The interaction:

The effect of organic, bio and mineral fertilizers , in addition, the roles of N, P and K elements in various stages of vegetative growth until yield production and quality. Similar results obtained by Darwesh (2002) on tomato, Anjaiah and padmaja (2006) and Sunandarani and Mallareddy (2007) on carrot.

CONCLUSION

From the above mentioned results it was noticed that fertilization with compost plus bio-fertilizer and 100% NPK gave the highest values of yield of carrot roots, but from the economical, environmental and quality parameters point of view, compost plus bio-fertilizer mixture or EM and 75% NPK treatment is recommended since it gave more yield than 100% NPK alone and gave the highest values of carrot quality parameters (total carotene which is a source of vitamin A, non-reducing sugars which enhances the sweetness of roots and a reduction in nitrate accumulation carrot roots).

REFERENCES

Abdel Naby, H.M.E.; K.K. Dawa; E.E. El-Gamily and N.M. Salem (2012). Effect of mineral, organic fertilization and some foliar application treatments on growth and bulb yield of onion. J. Plant Production, Mansoura Univ., Vol. 3(8):2265-2276.

Abou-Bakr, M.H.A.; H.R. Hassan and M.A. Nassar Dalia (2005). Effect of soil treatment with effective microorganisms as bio-ertilizer on morphological characters, yield and anatomical structure of potato plant (*Solanum tuberosum* L). Egypt J. Agric. Sci., Mansoura Univ., 30(11): 6701-6721.

Abou-Hussein, S.D.; U.A. El-Bahiry; I. El-Oksh and M.A. Kalafallah (2002). Effect of compost, Biofertilizer and chicken manure on nutrient content and tuber quality of potato crops. Egypt. J. Hort., 29(1): 117-133.

Aggelides S.M. and P.A. Londra (2000). Effects of compost produced from town wastes and sewage sludge on the physical properties of a loamy and a clay soil. Biores. Technol., 71, 3, 253-259

Anjaiah, T. and G. padmaja (2006). Effect of potassium and *farmyard* manure on yield and quality of carrot. India J. of Research ANGRAU. 34:(2): 91-93. (CF comp. search.)

Ashwini kumar; M.K. Rana and K.S. Baswana. (2007). Effect of crop residues and farm yard manure on yield and quality of carrot (*Daucus carota* L.) roots. Horticultural Society of Haryana. 36: (314), 367-369.

Bruno, R. de LA; J.S. Viana; V.F. Silva; G.B. Bruno and M.F. Moura (2007). Production and quality of seeds and roots of carrot cultivated under organic and mineral fertilization. Hort. Brasileira., 25:2, 170-174.

Darwesh, F. M. A. (2002). Effect of different fertilizer sources and levels on growth, yield and quality of tomatoes. Ph.D. Thesis. Fac. Agric., Cairo Univ., Egypt.

Dawa, K.K; H.M.E. Abd El-Nabi and W.M.E. Swelam (2012). Response of sweet pepper plants (vegetative growth and leaf chemical constituents) to organic, biofertilizers and some foliar application treatments. J. Plant Production, Mansoura Univ., Vol. 3(9):2465-2478.

Dawa, K.K; E.A.A. Radwan and F.Y.O. Mansour (2012). Effect of chicken manure levels, biofertilizers and some foliar application treatments on garlic. J. Plant Production, Mansoura Univ., Vol. 3(3):571-586.

Dubois, M.; A. Gilles, J. K. Homilton, P.A. Rebers and P.A. Smith (1956) A colorimetric method for determination of sugars and related substances. Anal. Chem., 28(3): 350-356.

Gomez, K.N. and A.A. Gomez (1984). Statistical procedures for agricultural research. John Wiley and Sons, New York, 2nd ed., 68 P.

Hanafy Ahmed, A.H.; J.F. Mishriky and M.K. Khalil (2000). Reducing nitrate accumulation on lettuce (*Lactica sativa* L.) plants by using different bio-fertilizers. ICEHM, Cairo Uni. Egypt, Sep. 2000, 509-517.

Higa, T. and J.F. Parr (1994). Beneficial and effective microorganisms for a sustainable agriculture and environment. International Nature Farming Research Centre, Atami, Japan p. 16. (CF Comp. Search.).

Khan, Z.; S.A. Tiyagi; I. Mohmood and R. Rizvi (2012). Effect of N fertilization, organic matter and biofertilizers on growth and yield of chill in relation to management of plant-parasitic nematodes. Turk.J. Bot. 36:73-81. (CF Comp. Search.).

Kushwah, S.S and R.N.S. Banafar (2003). Influence of different N and P levels with and without bio- fertilizer on N, P contents, uptake and yield of potato. J.of the Indian Potato Assoc. 30 (3/4): 321-324. (CF CAB Abstracts 2005).

Lindani, N. and M.O. Brutsch (2012). Effects of the integrated use of effective micro-organisms, compost and mineral fertilizer on greenhouse-grown tomato. Afric. J. Plant Sci., 6(3): 120-124.

Mahmoud, E.; N. Abd EL-Kader; P. Robin; N. Akkal-Corfini and L. Abd El-Rahman (2009). Effects of different organic and inorganic fertilizers on cucumber yield and some soil properties. World J.Agric. Sci., 5 (4): 408-414.

Merghany, M.M.; A.F.M. Hosna; M.M. Shahien and M.A.A. El-Sayed (2008). Productivity improvement of carrot (*Daucus carota* L.) under north Sinai conditions. J. Agric. Sci. Mansoura Univ., 33 (12): 8777-8797.

Naguib, M.I. (1964). Medified Nelson Solution. Effect of serin on the carbohydrate and nitrogen metabolism during germination cotton seeds. Indian J. Exptl. Biol., 2: 149.

Okonwu, K. and S.I. Mensah (2012). Effect of NPK (15:15:15) fertilizer on some growth indicates of pumpkin. Asian J. of Agric. Res, 6: 137-143.

Ortas I, Kayaz and Cakmaki. (2001). Influence of VA Mycorrheiza inoculation on growth of maize and green pepper plants in phosphorus and zinc deficient soils. In: plant nutrition. Food security and sustainability of agroecosystems (Hors W.J. *et al.,* eds) Kluwer Acad Publ, Dordrecht.pp.632-633.

Sadasivam, S. and A. Manickam (1996). Biochemical methods, second edition, New age inter. India. (CF Comp. Search.).

Shehata, S.A.; A.A. Gharib; M.M. El-Mogy and K.F. Abd El-Gawad (2011). Influence of compost, amino and humic acids on the growth, yield and chemical composition of strawberries. J. Medicinal Plant Res., 5(11):2304-2308.

Singh, J. P. (1988). A rapid method for fertermination of nitrate in soil and plant extracts. Plant and soil. 110: 137-139.

Snedecor, G. W. and W. G. Cochran (1980). Statistical Methods, 7th Ed., Ames, IA: The Iowa State University Press.

Sunandarani, N. and K. Mallareddy (2007). Effect of different organic manures and inorganic fertilizers on growth, yield and quality of carrot (*Daucus carota* L.). India, Karnataka J. Agric. Sci. 20:3, 686-688.

Woodward, D. (2003). Soil and sustainability: Effective microorganisms as regenerative systems in earth healing .M.Sc. Dissertation. Brighton.Webhttp://www.livingsoil.co.uk/learning/soilsustain.html

Xu, H. (2000). Effects of a microbial inoculant and organic fertilizers on the growth, photosynthesis and yield of sweet corn. J. Crop Prod., 3:183–214.

Zahoor, A.; A. Nawab; A. Mushtaq; U.H. Saeed and A. Sohail (2005). Yield and economics of carrot production in organic farming. Department of Horticulture. NWFP Agricultural University, Peshawar- Pakistan. Sarhad . J. Agric. 21, 3. (CF Comp. Searc

تأثير التسميد العضوى و الحيوى و المعدنى على المحصول و الجوده لنباتات الجزر

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أجريت تجربتان حقليتان على محصول الجزر (شنتناى) خلال الموسمين الشتويين ٢٠٠٩/٢٠١٠ و ٢٠١٠/٢٠١١ بهدف دراسة تأثير التسميد الحيوي والعضوي و المعدنى والتفاعل بينهم على المحصول وصفات الجودة لنبات الجزر. أقيمت هذه التجربة فى مزرعة خاصة بمركز بني عبيد محافظة الدقهلية ونفذت التجارب فى تصميم الشرائح المتعامدة المنشقة في ثلاث مكررات واشتملت التجربة على ١٨ معامله تمثل التفاعلات بين ٢ معامله من التسميد العضوي و ٣ معاملات من التسميد الحيوي و٣ معاملات من التسميد المعدني وكان اجمالى عدد الوحدات التجريبية ٥٤.

انتهت الدراسة الى:

١. التسميد بالسماد العضوى (الكومبوست) اعطى اعلى القيم للمحصول وصفات الجوده.
٢. التسميد الحيوى سبب زياده معنوية ايضا للمحصول وصفات الجوده وكان التفوق عند استخدام المخلوط تلاه EM.
٣. التسميد المعدنى ١٠٠% NPK من الكمية الموصى بها اعطت اعلى قيم للمحصول بينما كانت افضل صفات للجوده ناتجه من التسميد بمعدل ٧٥% من الكمية الموصى بها.
٤. التداخل بين العوامل الثلاث تحت الدراسه الكومبوست والتسميد الحيوى (المخلوط او EM) و ١٠٠%NPK اعطى اعلى قيم لكمية المحصول بينما كان التفاعل بين الكومبوست و التسميد الحيوي(المخلوط أو EM) و ٧٥% NPK الاكثر تفوق بالنسبة لصفات الجوده عن باقى المعاملات كما تعطى كمية محصول مرتفعه مقارنه بالتسميد المعدنى ١٠٠%NPK فقط.

التوصية

من النتائج المذكوره سابقا لوحظ ان نباتات الجزر المسمده باستخدام الكمبوست والتسميد الحيوى (المخلوط او EM) و ١٠٠% NPK اعطى اعلى محصول مقارنه بباقى المعاملات.

ولكن من وجهة اقتصادية وبيئية نوصى باستخدام المعامله الكمبوست مع التسميد الحيوى (المخلوط او EM) و ٧٥% NPK حيث اعطت محصول مرتفع عن المعامله ١٠٠% NPK فقط وأعلى صفات جوده عن جميع المعاملات حيث سجلت أعلى القيم في الكاروتين (مصدر فيتامين أ) والسكريات الغير مختزله والتي تحسن من حلاوة الجذور كما خفضت من تراكم النترات في جذور الجزر ومن ثم تقليل الأسمدة المعدنية المستخدمة وتوفير جزء من التكاليف علاوه على الجوده العاليه للمحصول والتى تحسن من الحاله التسويقيه.

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