RESPONSE OF *PIMPINELLA ANISUM,* L. TO ORGANIC FERTILIZER TREATMENTS UNDER NEW LANDS CONDITIONS

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Abstract

This work was done at the Experimental Farm of El-Quassasien Hort. Res. Station, Ismailia Governorate, during the two successive seasons of 2010/2011 and 2011/2012 aiming to study the effect of compost (5, 10 and 15 m^3/fed.) with organic and biofertilizers, [i.e., V.B at 50 ppm, compost tea at 20 L./fed., active dry yeast at 6 g/L., humic acid at 20 cm^3/L. and effective microorganisms (EM) at 1 cm^3/L. beside control treatment (foliar with water only)] as well as the interaction between them on the growth, yield and its components, chemical constituents and essential oil percentage and content of anise plant under new reclaimed soil conditions. The obtained results show that, all levels of organic & biofertilizers and their interaction treatments enhanced the growth parameters, fruits yield/fed., essential oil percentage and content/plant. The interaction treatment between 15 m^3/fed. compost and EM gave the best results of plant height, both fresh and dry weights of herb/plant, number of inflorescences/plant, fruits yield/plant and fruits yield/fed., essential oil percentage and content/plant in fruits, nitrogen, phosphorus and potassium contents in herb during the two seasons. The GLC analysis of the volatile oil of anise fruits, indicated the presence of Limonene, γ-Terpinen, Para-Cymene, Estragole, Sesquiterpene hydrocarbon, Anethole and Anitholdehyde. The highest main components were Anethole, and Sesquiterpene hydrocarbon. The highest values of Anethole, and Sesquiterpene hydrocarbon were observed in the treatment of compost tea followed by the treatment of EM, respectively.

INTRODUCTION

Anise (*Pimpinella anisum* L.) is one of the most important annual medicinal plants from Apiaceae family in the world. Its active substances are used in various pharmaceutical and food industries (Nabizadeh *et al.*, 2012). The seeds of anise contain an essential oil (1 to 4%) (Klaus *et al.*, 2009). In folk medicine, anise is used as an appetizer, tranquillizer and diuretic drug (Lawless, 1999).

Environmental problems related to the use of synthetic fertilizers and to organic waste management have led to an increased interest in the use of organic materials as an alternative source of nutrients for crops, but this is also associated with N_2O emissions (Aguilera *et al.*, 2013).

It is well known that sandy soil is low fertile, low water retention , poor soil properties; i.e., physical, chemical and biological, and has high soil pH. To overcome

these drawbacks addition of organic matter, almost, can improve all soil properties; such as water holding capacity, soil aggregation, aggregation stability, soil fertility, and increase cation exchange capacity. Also, organic fertilizers were used to decrease soil pH and increase the availability of major and minor nutrients. For these reasons, there was a great attention to use organic fertilizers (compost) and biofertilizers in production of anise plants in order to reduce plant and soil contamination with different elements, to improve the soil properties.

Concerning the effect of compost on vegetative growth and chemical constituents in several plants, many authors described this trend as follow. Plant height, number of branches per plant, number of umbellate per plant, number of fruits per umbellate, fruits, yield and thousand fruits weights were affected positively by organic fertilizer and organic–inorganic fertilizer combination application on anise [Dogramaci and Arabaci (2010) and Khalil *et al.*, (2008)] on anise and sage plants, respectively, showed that all levels of compost (6, 12 and 18 m^3/fed.) significantly increased plant height, number of branches, fresh and dry weights of herb, oil (%) (in anise seeds and sage herb), as well as fruits, herb and oil yields/plant and per feddan in both plants, respectively, as compared to mineral fertilization. Also, the highest fruits yield, essential oil content and essential oil yield of anise fruits, were obtained with application of 10 ton/ha. vermicompost and bio fetilizer as compared to untreated plants (Darzi, 2012). (Khalesro *et al.*, 2012) also found that, fertilizing anise with the highest level of vermicompost (10 ton/hacter) and inoculation seeds with *Azotobacter*, *Azospirillum* and *Pseudomonas* led to significant increment in essential oil content and yield, as well as some chemical compositions as anethol, methyl chavicol percentage and nitrogen content in seeds.

The Vitamin B (thiamine) is useful for plant growth due to it's combined with two molecules of phosphoric acid to form thiamine pyrophosphate (TPP) which is the most active form that acts as a coenzyme necessary for oxidative decarboxylation of pyruvic acid from glycolysis to active acetate in Kreb,s cycle and this in turn affect the growth and yield of plants (Oertli, 1987).

Compost tea, in modern terminology is a compost extract, plant extracts, liquid manures and compost teas can be further understood in the context of their influences on the rhizosphere and phyllosphere, also, manure and compost tea production is a brewing process that extracts microorganisms from compost or manure followed by microbial growth and multiplication including beneficial bacteria, fungi and protozoa (Ingham, 2005).

As for the effect of active dry yeast, Eid (2001) studied the effect of four levels of foliar spray of active dry yeast (0, 1, 2 and 3 g/L.) on coriander plants and she was

found that, active dry yeast significantly increased plant height and number of branches. Ali (2009) on fennel plants found that, active dry yeast application at 2 and 4 gm/L. significantly increased plant height and number of main branches as well as leaves fresh weight of plant in the two seasons.

Concerning the humic acid, research has shown it is the humic fractions (humic acid, fulvic acid and humin) of the soil organic matter that are responsible for the generic improvement of soil fertility and improved productivity (Fortun *et al.,* 1989). Humic substances are organic compounds that resulted from the decomposition of plant and animal materials. Humic acid neutralize both acid and alkaline soils, regulate the pH-value of soils, chelating unavailable nutrients and buffering pH (Mackowiak *et al.*, 2001).

Effective Microorganisms EM_1 contains several types of microorganisms such as photosynthesis bacteria, lactic acid bacteria, yeast and actinomycetes are useful in the activation mycorrhiza in soil and encourages plant growth (Higa and Parr, 1994). EM_1 have a positive effect on the decomposition of organic matter, limiting putrefaction, increasing nitrogen content in the root medium of plants (the role of nitrifying bacteria), phosphorus (the role of actinomycetes), improving soil fertility and as a result contributing to growth and development of root systems of plants (Daly and Stewart, 1999).

Many studies were executed to explore the effectiveness of organic and biofertilizers such as Vitamin B, compost tea, active dry yeast, humic acid and effective microorganisms (EM_1) on different vegetative growth traits, seed yield and essential oil productivity of some medicinal plants. In this respect, Soliman (1997) on *Nigella sativa*; Ibrahim (2000) and Kandeel *et al.* (2001) on fennel; Abdou and El-Sayed (2002) on caraway; yousef (2002) on chamomile, Abd El-Kader and Ghaly (2003) on coriander; Badran *et al.*, (2003) on anise; Badran and Safwat (2004) and Abdou *et al.* (2004) on fennel, yousef *et al.* (2013) on Echinacea .

Therefore, the objective of this work was to investigate the effect of compost and different levels of organic and biofertilizers, i.e., Vitamin B, compost tea, active dry yeast, humic acid and effective microorganisms practices on the yield and essential oil quality with the general recommendation for improving the production of anise plants under new land condition.

MATERIALS AND METHODS

This work was done at the Experimental Farm of El-Quassasien Hort. Res. Station, Ismailia Governorate, during the two successive seasons of 2010/2011 and

2011/2012 aiming to study the effect of compost with organic and biofertilizers, i.e., Vitamin B, compost tea, active dry yeast, humic acid and effective microorganisms (EM) as well as the interactions between them on the growth, herb chemical contents, fruits yield and its components, essential oil percentage, content and its constituents in fruits of anise under new reclaimed soil.

The experiment included 18 treatments, which were the combinations between three levels of compost (5, 10 and 15 m^3/fed.) and five sources of organic and biofertilizers [V.B at 50 ppm, compost tea at 20 L./fed., active dry yeast at 6 g/L., humic acid at 20 cm^3/L. and EM at 1 cm^3/L. beside control treatment (foliar with water only)]. These treatments were arranged in a split plot design with three replicates. The compost levels were randomly arranged in the main plots and the organic & bioferetilizers sources were randomly distributed in the sub plots.

Compost tea, humic acid and EM were obtained from Soil, Water and Environment Research Institute, Agric. Res. Center, Giza, Egypt.

The physical and chemical properties of the used experimental soil in the average two seasons are shown in Table (A).

Table (A): The mechanical and chemical analysis of the experimental soil.

Physical analysis	Values	Chemical analysis	Values
Sand	88.88 %	Macro elements (ppm)	
Silt	5.0 %	Nitrogen	83
Clay	6.12 %	Phosphorus	24
Soil texture	Sandy	Potassium	104
		Micro elements (ppm)	
Field capacity (F.C.)	11.72 %	Fe	2.5
Welting point (W.P.)	2.31 %	Cu	---
Organic matter	0.39 %	Zn	0.25
pH (1 soil : 2.5 d.w.)	8.2	Mn	0.72
E.C. (mmohs/cm)	0.21	Anion (mq/100 g soil)	
		Cl^-	0.5
		HCO_3	1.0
		SO_4	0.96
		Cations (mq/100 g soil)	
		Ca^{++}	1.0
		Mg^{++}	0.4
		Na^+	0.74
		K^+	0.35
		$CaCO_3$ (meq/100 g soil)	2.4

Anise seeds were provided by the Department of Medicinal and Aromatic Plants, Horticulture Research Institute, A.R.C., Ministry of Agriculture, Giza, and sown at 25 cm apart on October 17th and 20th during the 1st and 2nd seasons, respectively. The

experimental unit area was 5.4 m^2. It contains three dripper lines with 3 m length each and 60 cm distance between the two dripper lines. One line was used to measure the morphological and physiological traits and the other two lines were used for yield determinations.

The compost was obtained from Arab Organization for Industrialization (A.O.I.) and applied during soil preparation at about 20 – 25 cm depth in the center of planting rows and covered by sand. The chemical composition of the compost fertilizer in the average two seasons is shown in Table (B).

Organic and biofertilizers sources were sprayed three times, the first after one month from planting and two weeks intervals. Each plot received 2 L. solutions of each concentration using spreading agent in all treatments to improve adherence of the spray to the plant foliage for increasing organic and biofertilizers absorption by the plants. The untreated plants (control) were sprayed with water and spreading agent.

Table (B): The chemical composition of compost fertilizer.

Compost characteristics		Results
The color		Dark brown
The smell		Acceptable
The Strength		Spongy
Wet weight per cubic meter	kg / m^3	510
Weight per cubic meter completely wet	kg / m^3	375
The moisture		26.60
Total nitrogen	%	1.50
Ammonium nitrogen	ppm	57
Nitrate nitrogen	ppm	95
Organic matter	%	35.3
Carbon organic	%	20.5
The ash	%	64.7
C:N ratio		1:13.7
Total phosphorus	%	0.38
Total potassium	%	0.63
Humic acid for organic matter	%	19.6
pH (1:10)		6.4
Grass seeds		No
Nematode		No
Parasites		No

The chemical and microbial composition of the compost tea is shown in Tables (C&D), Hendawy *et al.* (2010).

Table (C) : Soluble macro and micro - nutrients of used compost tea.

Turned compost tea								
E.C Ds/m	pH	Macro and micro-nutrients (ppm)						
		N	P	K	Ca	Mg	Fe	Zn
0.89	6.5	250	8	206	87	116	66	7

Table (D) : Microbial population of organic compost tea.

Bacterial pant count (CFU/ml)	$7.1X10^7$
Bacterial Direct count (Cell/ml)	$6.4X10^8$
Spore forming bacteria (CFU/ml)	$7X10^4$
Total fungi (CFU/ml)	$1.1X10^4$
Actinomycetes (CFU/ml)	$2.8X10^5$

(CFU/ml) = Colony Forming Unit.

All agriculture practices other than experimental treatments were performed according to the recommendations of the Ministry of Agriculture, Egypt.

Data Recorded

1. **Plant Growth**:

   A random sample of three plants from every sub plot were randomly taken at the flowering stage (the middle of March) in the two growing seasons to measuring the following parameters: Plant height, both fresh and dry weights of herb/ plant.

2. **Yield and its components:**

   At fruiting stage (the first week of May), the plants were harvested and the inflorescences and seed yield/plant were recorded and total seed yield/fed. was calculated by multiblying seed yield (g)/plant to 20000 plants/fed. divided on 1000, to get the weight in kg.

3. **Nitrogen, phosphorus and potassium contents in herb**:

   Total Nitrogen, phosphorus and potassium percentages were determined in dried and wet digested herb according to the methods described by A.O.A.C. (2005).

4. **Essential oil extraction:**

   The determination of the essential oil percentage, done using a Clevenger type apparatus as mentioned by (Kapoor *et al.*, 2004). The essential oil content (ml/plant) was calculated by multiblying essential oil percentage to the dry weight of fruits/plant.

5. **Gas liquid chromatography analysis of essential oil (GLC)**

   GLC analysis was determined for the essential oil in 6 samples from the organic and bio-fertilizers treatments under this study (V.B, compost tea, active dry yeast, humic acid, EM and control) under 15 m^3/fed. compost treatment in the first season. The oil samples were performed using a programmed procedure. The

quantitative estimation for each compound was based on the peak area measurement by triangulation (Guenther and Joseph, 1978).

The analysis was carried out in Medicinal and Aromatic Plants Dept. Giza, Doki, Horticulture Research Institute (HRI).

Statistical analysis:

All data were statistically analyzed according to Snedecor and Cochran (1980) and mean values of the treatments were compared by Duncan's Multiple Range Test according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

1. Plant growth

Data in Table (1) show that, the plant growth of anise plant (plant height, both fresh and dry weights of herb/plant) were affected by different levels of compost and bio-stimulants in both seasons.

Concerning, the effect of compost treatments, data indicated that, increasing the amount of compost fertilizer from 5 to 15 m^3/fed. gradually increased plant height and both fresh and dry weights of herb/plant in both seasons. The highest values were (53.16 and 57.16 cm), (50.96 and 57.33 g) and (12.82 and 14.26 g) for plant height, fresh and dry weights of herb/plant in the 1st and 2nd seasons, respectively, from the treatment of 15 m3/fed. with significant effects compared to pther treatments.

Table (1): Effect of organic and bio-fertilization treatments on plant growth parameters of anise plants during 2010/2011 and 2011/2012 seasons.

Characters / Treatments	Plant height (cm)				F.W of herb/plant (gm)				D.W of herb/plant (gm)			
Compost (m^3/fed.)	1st season		2nd season		1st season		2nd season		1st season		2nd season	
	Effect of organic fertilizer											
5	46.50	c	51.11	b	28.02	c	31.23	c	6.31	c	8.16	c
10	49.66	b	53.11	b	36.63	b	39.78	b	8.77	b	10.03	b
15	53.16	a	57.16	a	50.96	a	57.33	a	12.82	a	14.26	a
Bio-fertilizers	Effect of bio-fertilizers											
Control	46.88	c	46.44	c	24.35	f	29.63	f	5.34	e	7.02	f
V.B at	47.22	c	53.22	b	29.13	e	33.33	e	7.31	d	8.56	e
Compost tea	49.77	b	53.88	b	39.81	c	43.15	c	9.54	c	10.52	c
Active dry yeast	50.11	b	57.77	a	35.23	d	39.24	d	8.61	c	9.68	d
Humic acid	52.00	a	52.22	b	46.86	b	50.17	b	11.51	b	12.96	b
E.M	52.66	a	59.22	a	55.84	a	61.17	a	13.50	a	16.16	a

Respecting , the effect of organic and biofertilizers treatments (V.B, compost tea, ctive dry yeast, humic acid and EM) on plant growth parameters of anise plant, such data in the same Table indicated that, treated plants with organic and bio-stimulants had significant effect on all plant growth traits, i.e., plant height, both fresh and dry weights of herb/plant in both seasons compared to control (spraying only with water). The highest significant values were obtained with sprayed plants with EM at 1 cm^3/L. (52.66 and 59.22 cm), (55.84 and 61.17 g) and (13.50 and 16.16 g) for plant height, both fresh and dry weights of herb/plant in the 1st and 2nd seasons, respectively, with insignificant differences between humic acid in the 1st season and active dry yeast in the 2nd season, respecting plant height.

Regarding the effect of the interaction between the compost fertilizer and organic & bio-fertilizer treatments on plant height, both fresh and dry weights of herb/plant, the data in Table (2) indicated that, the interaction treatments showed significant effect in all plant growth characters in both seasons. Fertilization of anise plants with 15 m^3/fed. and sprayed plant with EM at 1 cm^3/L. was the best treatment for enhancing all plant growth traits in both seasons and recorded the highest values in this respect (56.00 and 65.33 cm), (71.06 and 82.73 g) and (18.03 and 21.50 g) for plant height, fresh and dry weights of herb/plant in the first and second seasons, respectively.

Table (2): Effect of interaction between organic and bio-fertilization treatments on plant growth of anise plants during 2010/2011 and 2011/2012 seasons.

Treatments \ Characters		Plant height (cm)				F.W of herb (gm)/plant				D.W of herb (gm)/plant			
Compost	Biofertilizers	1st season		2nd season		1st season		2nd season		1st season		2nd season	
5	Control	45.66	f	40.33	g	18.23	l	20.73	l	2.80	i	4.30	k
	V.B	41.33	g	50.66	d-f	18.23	l	21.13	l	3.30	i	5.40	jk
	Compost tea	47.33	d-f	54.66	b-e	33.23	i	36.70	hi	7.90	fg	9.00	hi
	Active dry yeast	47.33	d-f	56.66	bc	24.00	ik	29.86	j	6.16	gh	8.10	i
	Humic acid	48.00	d-f	50.66	d-f	35.90	g-i	39.10	gh	8.83	ef	10.96	ef
	E.M	49.33	de	53.66	b-e	38.56	fg	39.90	g	8.86	ef	11.23	d-f
10	Control	45.66	f	45.66	fg	21.23	kl	24.73	k	4.93	hi	6.06	j
	V.B	47.00	ef	53.33	b-e	26.73	j	29.90	j	6.86	fg	8.20	i
	Compost tea	49.33	de	52.66	c-e	37.43	gh	40.63	g	8.70	f	9.46	gh
	Active dry yeast	50.33	cd	59.00	b	31.76	i	34.73	i	7.66	fg	8.60	hi
	Humic acid	53.00	a-c	49.33	ef	44.73	de	47.80	e	10.86	de	12.10	c-e
	E.M	52.66	bc	58.66	b	57.90	b	60.90	c	13.60	bc	15.76	b
15	Control	49.33	de	53.33	b-e	33.60	hi	43.43	f	8.30	fg	10.70	fg
	V.B	53.33	a-c	55.66	b-d	42.43	ef	48.96	e	11.76	cd	12.10	c-e
	Compost tea	52.66	bc	54.33	b-e	48.76	cd	52.13	d	12.03	cd	13.10	c
	Active dry yeast	52.66	bc	57.66	bc	49.93	c	53.13	d	12.00	cd	12.36	cd
	Humic acid	55.00	ab	56.66	b-d	59.96	b	63.63	b	14.83	b	15.83	b
	E.M	56.00	a	65.33	a	71.06	a	82.73	a	18.03	a	21.50	a

2. Yield and its components

Data recorded in Table (3) indicated that, number of inflorescences, fruits yield (g)/plant and fruits yield (kg)/fed. were significantly affected by compost fertilizer, organic and bio-stimulants treatments, in both seasons.

As for the effect of compost fertilizer, data indicated that increasing the amount of compost fertilizer from 5 to 15 m^3/fed. resulted in increasing the number of inflorescences, fruits yield/plant and fruits yield/fed. in both seasons. The application of 15 m^3/fed. compost had significantly increased all abovementioned traits and gave the maximum values (34.06 and 43.50) , (23.26 and 23.42 g) and (465.22 and 468.44 g) for number of inflorescences, fruits yield/plant and fruits yield/fed. in both seasons, respectively.

With regard to, the effect of organic and bio-stimulants treatments, it's evident from results in the same Table that, the number of inflorescences, fruits yield/plant and fruits yield/fed. in the two seasons showed significant increases with using organic and biofertilizer treatments when compared with control. The maximum values of all yield characters were obtained from the treated anise plants with 1 cm^3/L. EM (33.21 and 43.78/plant), (28.11 and 26.77 g/plant) and (562.22 and 535.33 kg/fed.) for number of inflorescences, fruits yield/plant and fruits yield/fed. in the 1st and 2nd seasons, respectively, with insignificant difference between humic acid and EM with respect to inflorescences number in the 1st season. On the other side, treated anise plants with humic acid came in the second rank in this respect.

Table (3): Effect of organic and bio-stimulants treatments on fruits yield parameters of anise plants during 2010/2011 and 2011/2012 seasons.

Characters / Treatments	No of inflorescences /plant		Fruits yield/plant (gm)		Fruits yield/fed. (kg)	
Compost (m^3/fed.)	1st season	2nd season	1st season	2nd season	1st season	2nd season
	Effect of organic fertilizer					
5	22.28 c	27.89 c	15.13 c	15.66 c	302.56 c	313.00 c
10	26.89 b	36.00 b	19.26 b	18.18 b	385.33 b	363.56 b
15	34.06 a	43.50 a	23.26 a	23.42 a	465.22 a	468.44 a
Bio-fertilizers	Effect of bio-fertilizers					
Control	21.44 d	22.67 e	11.31 f	11.52 f	226.44 f	230.44 f
V.B at	26.44 c	32.44 d	12.60 e	13.46 e	252.00 e	269.11 e
Compost tea	28.33 b	39.67 b	21.23 c	19.93 c	424.67 c	398.22 c
Active dry yeast	25.89 c	37.78 c	18.40 d	17.57 d	368.00 d	351.33 d
Humic acid	31.22 a	38.44 bc	23.64 b	25.28 b	472.89 b	505.56 b
E.M	33.21 a	43.78 a	28.11 a	26.77 a	562.22 a	535.33 a

Table (4): Effect of interaction between organic and bio-fertilization treatments on fruits yield parameters of anise plants during 2010/2011 and 2011/2012 seasons.

Treatments \ Characters		No of inflorescences /plant		Fruits yield/plant (gm)		Fruits yield/fed. (kg)	
Compost (m^3/fed.)	Bio-fertilizers	1st season	2nd season	1st season	2nd season	1st season	2nd season
5	Control	13.66 j	18.33 j	8.30 j	9.40 j	166.00 n	188.00 m
	V.B	21.66 i	25.67 hi	9.50 ij	10.87 ij	190.00 m	217.33 l
	Compost tea	22.00 hi	33.33 fg	18.03 e	17.03 g	360.67 g	339.33 i
	Active dry yeast	21.33 i	27.67 h	13.50 gh	14.20 h	270.00 j	284.00 j
	Humic acid	26.33 efg	27.33 h	18.83 e	19.33 f	376.67 f	386.67 g
	E.M	28.66 cde	35.00 fg	22.60 cd	23.13 de	452.00 d	462.67 e
10	Control	23.00 ghi	22.67 i	10.67 i	10.83 ij	214.00 l	216.67 l
	V.B	24.66 fghi.	32.33 g	12.33 h	12.50 hi	246.67 k	250.00 k
	Compost tea	26.00 efg	40.33 e	21.47 d	18.40 fg	429.33 e	368.00 h
	Active dry yeast	25.33 efgh	36.00 f	18.97 e	16.97 g	379.33 f	339.33 i
	Humic acid	30.00 bcd	40.00 d	24.07 c	26.30 c	481.33 c	526.00 c
	E.M	32.66 b	44.67 h	28.07 b	24.07 d	561.33 b	481.33 d
15	Control	27.66 def	27.00 e	14.97 fg	14.33 h	299.33 i	286.67 j
	V.B	33.00 b	39.33 e	15.97 f	17.00 g	319.33 h	340.00 i
	Compost tea	37.00 a	45.33 cd	24.20 c	24.37 cd	484.00 c	487.33 d
	Active dry yeast	31.00 bc	49.67 ab	22.73 cd	21.53 e	454.67 d	430.67 f
	Humic acid	37.33 a	48.00 bc	28.03 b	30.20 b	560.67 b	604.00 b
	E.M	38.33 a	51.67 abc	33.67 a	33.10 a	673.33 a	662.00 a

Regarding the interaction treatments (compost fertilizer with the organic and bio-stimulants treatments), data tabulated in Table (4) show that, the interaction between compost fertilizer at 15 m^3/fed. plus EM at 1 cm^3/L. resulted in the highest traits of yield (38.33 and 51.67), (33.67 and 33.10 g) and (673.33 and 662.00 kg) for number of inflorescences, fruits yield/plant and fruits yield/fed. in the 1st and 2nd seasons, respectively, with insignificant differences between 15 m^3/fed. compost + compost tea, humic acid or EM in the 1st season and 15 m^3/fed. compost plus active dry yeast or EM in the 2nd season, regarding number of inflorescences.

3. Mineral contents

Nitrogen, phosphorus and potassium percentages had affected by application of compost fertilizer and organic and bio-stimulants in both seasons (Table, 5). Application of compost to anise plants significantly affected N, P and K contents in herb. The highest percentages of three minerals in leaves were obtained by 15 m^3/fed. compost fertilizer. While the lowest values were obtained by 5 m^3/fed. compost fertilizer. Addition of 10 m^3/fed compost gave intermeddle values between them in both seasons.

Table (5): Effect of organic and bio-stimulants treatments on mineral contents of anise plants during 2010/2011 and 2011/2012 seasons.

Characters / Treatments	N		P		K	
Compost (m^3/fed.)	1st season	2nd season	1st season	2nd season	1st season	2nd season
	Effect of organic fertilizer					
5	1.46 c	1.66 c	0.151 c	0.171 c	1.72 c	1.95 c
10	1.50 b	1.70 b	0.156 b	0.177 b	1.87 b	2.12 b
15	1.53 a	1.72 a	0.161 a	0.184 a	2.11 a	2.38 a
Bio-fertilizers	Effect of biofertilizers					
Control	1.30 f	1.50 e	0.132 f	0.152 f	1.30 f	1.55 f
V.B	1.43 e	1.61 d	0.144 e	0.165 e	1.62 e	1.83 e
Compost tea	1.57 c	1.74 b	0.156 c	0.177 c	1.98 c	2.26 c
Active dry yeast	1.50 d	1.71 c	0.149 d	0.171 d	1.77 d	2.02 d
Humic acid	1.59 b	1.80 a	0.169 b	0.190 b	2.26 b	2.50 b
E.M	1.61 a	1.79 a	0.186 a	0.211 a	2.47 a	2.72 a

As for organic and bio-stimulants, data in the same Table show that, organic and bio-stimulants had significant effect on N, P and K percentages in herb during both seasons. Treated anise plants with EM at 1 cm^3/L. gave the highest increases in N, P and K contents in herb in both seasons, with no significant differences with humic acid at N respecting in herb in the 2nd season.

Concerning the effect of the interaction between compost levels and organic and bio-fertilizers on N, P and K percentages in herb, data in Table (6) indicated that, the interaction between organic and bio-fertilizers had significant effect on mineral contents in herb in the two seasons. The best interaction treatments for increasing N, P and K percentages were obtained in plants fertilized with 15 m^3/fed. compost and treated with EM at 1 cm^3/L in both seasons. On the other hand, fertilization of anise with compost at 5 m^3/fed. only recorded the lowest values of N, P and K contents in herb during the two seasons.

Table (6): Effect of interaction between organic and biofertilization treatments on mineral contents of anise plants during 2010/2011 and 2011/2012 seasons.

Characters / Treatments		N		P		K	
Compost (m^3/fed.)	Biofertilizers	1st season	2nd season	1st season	2nd season	1st season	2nd season
5	Control	1.26 m	1.44 n	0.126 o	0.145 m	1.22 n	1.44 m
	V.B	1.40 j	1.55 l	0.140 l	0.159 k	1.54 k	1.76 j
	Compost tea	1.53 fg	1.73 f-h	0.151 i	0.171 h	1.83 h	2.04 h
	Active dry yeast	1.46 h	1.69 ij	0.145 k	0.166 ij	1.70 i	1.93 i
	Humic acid	1.54 f	1.79 bc	0.164 f	0.186 e	1.93 f	2.22 g
	E.M	1.59 de	1.75 d-f	0.181 c	0.201 c	2.10 e	2.30 f
10	Control	1.30 l	1.50 m	0.132 n	0.153 l	1.29 m	1.54 l
	V.B	1.43 i	1.62 k	0.144 k	0.164 j	1.62 j	1.83 j
	Compost tea	1.57 e	1.77 c-e	0.156 h	0.180 fg	1.88 g	2.21 g
	Active dry yeast	1.51 g	1.71 hi	0.148 j	0.170 hi	1.71 i	1.93 i
	Humic acid	1.58 de	1.81 b	0.168 e	0.190 e	2.23 d	2.45 e
	E.M	1.62 bc	1.78 cd	0.186 b	0.206 b	2.52 c	2.74 c
15	Control	1.35 k	1.56 l	0.137 m	0.158 k	1.40 l	1.68 k
	V.B	1.45 hi	1.66 j	0.150 ij	0.171 h	1.71 i	1.91 i
	Compost tea	1.60 cd	1.72 gh	0.161 g	0.181 f	2.24 d	2.54 d
	Active dry yeast	1.53 fg	1.74 e-g	0.155 h	0.177 g	1.90 fg	2.20 g
	Humic acid	1.64 ab	1.79 bc	0.174 d	0.194 d	2.62 b	2.84 b
	E.M	1.65 a	1.85 a	0.190 a	0.225 a	2.80 a	3.12 a

4. Essential oil content:

The results on essential oil percentage and content/plant as affected by compost treatments presented in Table (7) and illustrated in Fig. (1) show that, increasing compost from 5 to 15 m^3/fed. increased essential oil percentage and significantly increased essential oil content (ml)/plant. The best treatment was that of 15 ton/fed. compared to the other treatments under study, in both seasons.

It is obvious from data in Table (7) and showed in Fig. (1) that, all examined treatments of organic and bio-fertilization resulted in increments in essential oil percentage and significant increases in essential oil content (ml)/plant. However, the highest values were recorded by using the treatment of EM followed by Humic acid, compost tea, yeast, V.B and control, during both seasons.

According to data tabulated in Table (7) in essential oil percentage and essential oil content (ml)/plant as affected by the combined treatments between compost levels and different kinds of organic and bio-fertilization on *Pimpinella anisum* plants, it could be concluded that, the highest effects were observed with the interaction treatment of compost at the rate of 15 m^3/fed. with EM. The differences between all treatments were significant, during the two seasons.

Table (7): Effect of compost rates, organic and bio-fertilizers and their combination treatments on essential oil content of anise fruits during 2010/2011 and 2011/2012 seasons.

Biofertilizers (B) / Compost (m^3/fed.) (A)	Control		V.B		Compost tea		Active dry yeast		Humic acid		E.M		$M_{(A)}$	
First season														
Oil percentage														
5	0.61		0.52		0.76		0.76		0.72		1.17		0.76	
10	0.62		0.61		0.78		0.80		0.85		1.19		0.81	
15	0.75		0.83		0.8		0.85		0.88		1.20		0.89	
$M_{(B)}$	0.66		0.65		0.78		0.80		0.82		1.19			
	Oil content (ml.)/plant													
5	0.051	i	0.049	i	0.137	f	0.103	g	0.163	e	0.220	c	0.120	c
10	0.066	hi	0.075	h	0.167	e	0.152	ef	0.238	c	0.286	b	0.164	b
15	0.112	g	0.133	b	0.193	d	0.193	d	0.296	b	0.336	a	0.211	a
$M_{(B)}$	0.076	e	0.086	e	0.166	c	0.149	d	0.232	b	0.281	a		
Second season														
Oil percentage														
5	0.62		0.55		0.77		0.78		0.77		1.18		0.78	
10	0.64		0.63		0.79		0.81		0.83		1.20		0.82	
15	0.73		0.81		0.81		0.87		0.89		1.21		0.89	
$M_{(B)}$	0.66		0.66		0.79		0.82		0.83		1.20			
Oil content (ml.)/plant														
5	0.058	h	0.060	h	0.131	efg	0.111	fg	0.149	e	0.273	b	0.130	c
10	0.070	h	0.079	h	0.145	e	0.138	ef	0.218	c	0.289	b	0.156	b
15	0.105	g	0.138	ef	0.197	cd	0.187	d	0.269	b	0.401	a	0.216	a
$M_{(B)}$	0.078	d	0.092	d	0.158	c	0.145	c	0.212	b	0.321	a		

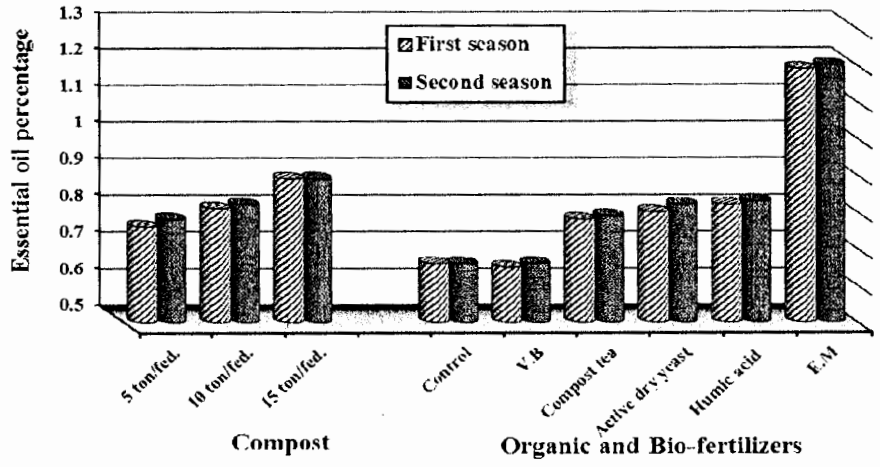

Fig. (1): Effect of compost rates and organic and bio-fertilizers treatments on essential oil content of anise seeds during 2010/2011 and 2011/2012 seasons.

Table (8). Effect of biofertilization treatments on volatile oil constituents of anise seeds. during first season.

Constituents \ Treatments		Control	V.B	Compost tea	Active dry yeast	Humic acid	E.M
1-	Limonene	0.02	0.12	0.86	0.09	0.77	0.75
2-	γ-Terpinen	0.05	0.18	0.07	0.17	0.08	0.09
3-	Para-Cymene	0.08	0.32	0.15	0.28	0.17	0.38
4-	Estragole	0.82	2.17	1.27	1.92	2.05	2.14
5-	Sesquiterpene hydrocarbon	2.75	3.86	3.09	3.18	3.25	2.64
6-	Anethole	76.21	78.02	87.06	78.19	79.55	85.69
7-	Anitholdehyde	2.18	1.31	3.12	2.21	3.06	2.57
	Unknown	16.89	14.02	4.38	13.96	11.07	5.74

Gas chromatograms of anise seeds volatile oil distilled as affected by different organic and bio-fertilizers treatments:

Data in Table (8) clearly indicate that, GLC analysis of the volatile oil of anise revealed the presence of Limonene, γ-Terpinen, Para-Cymene, Estragole, Sesquiterpene hydrocarbon, Anethole and Anitholdehyde in all treatments. However, all treatments increased the total components of volatile oil, especially the treatment of EM followed by the treatment of compost tea. Anyway, the highest main components of anise seeds volatile oil were Anethole, and Sesquiterpene hydrocarbon, respectively. The highest values of Anethole, and Sesquiterpene hydrocarbon were observed in the treatment of compost tea followed by the treatment of EM, respectively.

DISCUSSION

These results may be due to the converting of the unavailable forms of nutrient elements to available forms by the microorganisms in biofertilizer. The microorganisms also produce growth promoting substances resulting in more efficient absorption of nutrients, which main components of photosynthetic pigments as well as N, P and K percentages were increased (Gomaa and Abou-Aly, 2001). These results agree with those of Badran and Safwat (2004) on fennel El-Ghadban *et al.* (2006) and Ordookhani *et al.*.(2011).

RECOMMENDATION

We can recommend to accomplishment good fruits and essential oil yields in anise plant that:

Fertilizing plants with compost fertilizer at 15 m^3/fed. and adding Effective Micoorganisms (EM) at 1 cm^3/L. under new land in El-Quassasien, Ismailia Governorate region.

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إستجابة الينسون لمعاملات السماد العضوى تحت ظروف الأراضى الجديدة

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أقيم هذا البحث فى المزرعة البحثية بمحطة بحوث البساتين بالقصاصين ، محافظة الإسماعيلية ، خلال موسمى الزراعة ٢٠١٠/٢٠١١ و ٢٠١١/٢٠١٢ بهدف دراسة تأثير سماد الكومبوست (٥ ، ١٠ و ١٥ م^{٣}/فدان) مع الأسمدة العضوية والحيوية (فيتامين ب ٥٠ جزء فى المليون ، شاى الكومبوست ٢٠ لتر/فدان ، الخميرة الجافة النشطة ٦ جم/لتر ، حمض الهيوميك ٢٠ سم^{٣}/لتر و الكائنات الحية الدقيقة النشطة **EM** ١ سم^{٣}/لتر بالإضافة إلى معاملة الكنترول بالرش بالماء فقط) والتفاعل بينهما على النمو والمحصول ومكوناته والمكونات الكيماوية ونسبة وكمية الزيت الطيار فى نبات الينسون تحت ظروف الأراضى المستصلحة حديثا.

النتائج المتحصل عليها أظهرت أن كل مستويات الكومبوست وكل الأسمدة العضوية والحيوية ومعاملات التفاعل بينهما أثرت على صفات النمو ومحصول الثمار/فدان ونسبة الزيت الطيار وكميته/نبات. معاملة التفاعل بين ١٥ م^{٣}/فدان كومبوست مع **EM** أعطت أفضل نتائج فى طول النبات والوزن الطازج والجاف للعشب/نبات وعدد النورات/نبات ومحصول الثمار/فدان ونسبة الزيت الطيار وكميته بالثمار/نبات ومحتوى العشب من النيتروجين والفوسفور والبوتاسيوم خلال الموسمين.

التحليل الكروماتوجرافى للزيت الطيار فى بذور الينسون أثبت إحتوائه على الليمونين ، ٧-تيربينين ، بارا-سيمين ، إستراجول ، سيسكويتيربين هيدروكربون ، أنيثول وأنيثولديهيد. أكبر نسبة كانت للمركبين الأنيثول وسيسكويتيربين هيدروكربون . ومعاملة شاى الكومبوست أعطت أكبر نتيجة لكلا المركبين ويليها فى التأثير معاملة **EM** .