Effect of Some Macro Elements and Bio Fertilization on The Growth, Yield and Chemical Composition of Coriander Plant (*Coriandrum sativum* L.)

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ABSTRACT: Coriander (*Coriandrum sativum,* L.) is an important medicinal herbs worldaride. The objective of this study was to investigate the effect of mineral and bio fertilization on vegetative growth, yield, and chemical composition including essential oil**;** as well as, major compounds of *Coriandrum sativum* L. Therefore, two filed experiments were conducted at the Experimental Farm of the Nubaria station-ELbeharia**,** Egypt during 2013/2014 and 2014/2015 growing seasons. The experimental design was split plot design with three replicates. Mineral fertilizer levels (control, 50% NPK, 75% NPK and 100% NPK) occupied the main plots. The sub plot was assigned to five bio-fertilizer treatments, i.e.,uninoculation, phosphorein, cerealine, potassomage and mixed bio-fertilizer). Theresultsobtained could be summarized as follows: (1) the addition of mineral fertilizer at rate of 100% resulted in a significant increment in vegetative growth,yield and chemical composition of coriander plants during both seasons, (2) the application of 100%NPK with mixture of biofertilizers (phosphorein +cerealine + potasisomage) was the best combination to obtain the highest mean values of plant height, number of branches/plant, fresh and dry weights of herb/plant, number of umbels/plant, 100-seed weight and seed yield/fed, as well as, oil %, but major compounds resulted fromcombination of 75 % NPK with potassomage and mix of biofertilizers for the coriander were tested in this study. However, of traits under study increased significantly, due to inoculation treatments over the uninoculation (control) one and the mixture of biofertilizers was the best treatment. This investigation suggests the need for more studies concerning the effect of NPK fertilizer rates and biofertilizers on coriander plants under different environments using different types of soil in order to reach the optimum combination to achieve the best yield.
Keywords: Mineral fertilizers, biofertilization, coriander major compounds.

INTRODUCTION

Coriandrum sativum L. (coriander)Fam.Apiaceae is an important fresh culinary herb in the United States, widely used in Mexican, African and Asian cuisines (Cantwell and Reid, 1993). It is used as a spice in a wide variety of foods. The pungent leaves are called "cilantro" a basic ingredient in Latin American and Asian cooking. The leaves (cilantro) have a bold taste, combining a strong sage flavor with sharp-citrus noted. The roots are similar with an added nutty flavor and are used fresh only. The seeds of coriander have a taste of citrus and are used in medicinal house hold cosmetics and fragrance (Rashed, 2002).

Fertilization is one of the most important factors limiting the productivity of plants. The intensive use of expensive mineral fertilizers results in environmental pollution problems. Further, chemical fertilizers at extremely high rates to a long period decreased the potential activity of microflora and the stability of soil organic matter (Hussien, 1995).Also, bio-fertilization is an important factor being used to produce products without some mineral fertilizer that cause environmental pollution problems. Hence, the attention has been focused on the recreates of biofertilizers to safe alternative specific chemical fertilizers. Biofertilizers play a vital role for increasing the number of microorganisms and accelerate certain microbial process in the rhizosphere of inoculated soil of plants (Kandeel *et al.,* 2001;Rashed, 2002; Mohamed and Abdu, 2004). This research, however, is an attempt to find out the best fertilization treatments (mineral NPK and biofertilizer on the vegetative growth, yield and chemical composition of corianderplants (*Coriandrum sativum* L.).

MATERIALS AND METHODS

Two filed experiments were carried out at the Experimental Farm of the Nubaria station, El-beharia, Egypt during both seasons of2013/2014 and 2014/2015, to study the effect of NPK, biofertilizer and their interaction on the growth,yield, chemical composition of coriander plants(*Coriandrum sativum* L.). The experimental design followed in this work was a split plot design with three replicates.where as the chemical fertilizers were arranged as maim plots and biofertilizers were arranged as sub plots. The replicate contain 20 treatments. The coriander seeds were sown on November 11^{th} and 12^{th}during both growing seasons. Each sub plot in both experimental seasons was 3.5 meters long and 3 meter wide (10.5 m^2 i.e. 1/400 feddan) contained 10 rows 25 cm apart between plants. The applied chemical fertilizer were ammonium sulphate (20.5% N), calcium superphosphate (15.5%P_2O_5) and potassium sulphate (48% K_2O) at the rates of (100, 100 and 50 kg/fed), respectively which are the recommended dose. The used biofertilization of bacteria was phosphorein (*Bacillus megatherium* phosphorus dissoliving bacteria P. D.B.), potassiomage biofertilizer contains of *Bacillus* mucilaginousas a potassium dissolving bacteria (KDB) or potassium solubilizing bacteria (KSB) and cerealine (*Azosprillum lipoferum* and *Azotobacter chroococcum*) which supplied by Natioal Research Center. The inoculation with phosphorein, potassiomage and cerealine were performed by coating coriander seed with each product individually using a sticking substance (Arbic gum at 5%) just before sowing. The recommended dose of NPK was divided into two equal parts, the first one was applied one month after sowing and the second one was applied before the first irrigation. The tested treatments were conducted as follows:

A) <u>NPK fertilizer (Main plot)</u>
- Control (without fertilization)
- 50% NPK
- 75% NPK
- 100% NPK

B) <u>Biofertilization (sub plot)</u>
- Uninoculation (control)
- Phosphorein
- Cerealine
- Potassiomage
- Mixture (phosphorein + cerealine + potassiomage)

The physical and chemical characteristics of the experimental soil are given in Table (1) .The soil was analyzed according to the methods described by Page *et al.* (1982). At harvest dates on April 8^{th} and 10^{th}during the two seasons, guarded plants were randomly taken from each plot and the following characteristics were recorded:

1. Plant height (cm)
2. Number of branches
3. Fresh and dry weight (g)/plant
4. Number of umbles/plant
5. 100-seed weight (g)
6. Seed yield (g)/plant
7. Seed yield (ton/fed)
8. Total chlorophyll (mg/g fresh weight)was determined in fresh leaves, samples of the fifth leaf from top at harvesting using the methods by Moran (1982).
9. The N, P and K contents were determined in the leaves which were driedat 70℃ for 48hr., and ground leaves (0.5 g) were digested with sulphuric acid and hydrogen peroxide H_2SO_4. H_2O_2 according to the method of Lowther (1980) and the following determination were carried out in the digested solution to determine the following:

- Nitrogen content (N%)
  Nitrogen was determined in the digested plant material colorimetrically by Nessler`smethod(Chapman and Pratt, 1978).

- Phosphorus content (P %)
  Phosphorus was determined by the Vanadomolyate yellow methodas given by Jackson (1973) and the intensity of color developed was read by spectrophotometer at 405nm.

- Potassium content (K %)
  Potassium was determined according to the method described by Jackson (1973) using Beckman Flame photometer.

- Essential oil percentage was determined in the air-dried seeds according to British Pharmacopocia (1963) by water distillation 40 g of herb for 1.5-2 hour, in order to extract the essential oil.

- The percentage of major compounds (linolool, α- 2-deenol, α-pinene,camphor and geraniol) were estimated by measuring the peak area of the different compounds of the chromatogram according to Heftman (1967) and Gunther and Joseph (1978).

The obtained data were analyzed statistically for ANOVA and L.S.D. values were calculated to least differences between the studied treatments according to Gomez and Gomez (1984).

Table (1). Physical and chemical analysis of the used soil before planting (average of 2013/2014 and 2014/2015seasons.

Parameter	Sample	Unit
Mechanical Analysis		
Sand	67	%
Silt	16	%
Clay	17	%
Textural class	Sandy loam	
pH (1:1)	7.55	-
EC(1:1, water extract)	3.3	dS/m
OM	0.32	%
Soluble cations		
Ca^{2+}	9.52	meq/l
Mg^{2+}	8.16	meq/l
Na^{+}	11.76	meq/l
K^{+}	1.28	meq/l
Soluble anions		
$HCO3^{-}$	2.7	meq/l
Cl^{-}	7.5	meq/l
SO_4^{2-}	11.73	meq/l
Available nutrients		
Nitrogen (N)	267.7	mg/kg
Phosphorus (P)	41.00	mg/kg
Potassium (K)	300.0	mg/kg

RESULTS AND DISCUSSION

A) Growth parameters and yield

Data in Tables (2 and 3) revealed that the fertilization treatment of 100 % NPK gave, significantly, the highest plant height, number of braches/plant, fresh and dry weight (g)/plant, number of umbles, 100-seed weight, seed yield (g)/plant and seed yield (ton)/fed, while, the least growth parameters and yield was obtained from the control treatment during both seasons. It could be concluded that, the role of available mineral nutrition as essential elements in building coriander umbles due to the positive effect of NPK in increasing the vegetative growth photosynthetic, as well as, the increasing seed yield (ton)/fed. These results coincided with those obtained by El-Mahrouk (2000) on *Swietteina mahogany* seedling, reported that 120+ 240 + 120 kg NPK/fed and 24 l/day; gave the highest significant plant growth, also, Reshad (2002)recorded similar trendon coriander, too.

The obtained results given in Tables (2 and 3)decleared that biofertilizers treatments exhibited a significant effect on all estimated traits during both seasons. Inoculation of mixture biofertilizer (phosphorein + cerealine + potassiomage) significantly increased growth parameters and yield. This finding could explain this positive effect of this mixture on growth characters and some yield in response to the phosphate potassium solubilizing bacteria and N-fixing bacteria (cerealine) where this mixture may increase the synthesis of endogenous phytohormones i.e. indol acetic acid (IAA), gibberelline (GAS) and cytokinene(CKs) which play an important role in formation of a big active shoot and root systems which allow more nutrition uptake which reflect positively on both systems. The previous results agree, more or less, with the findings of Gad (2001) on *Aneithum graveolens*, Rashed (2002) on coriander, Abdel Latif (2002) on C*ariumcarvi* and Kandee l*et al.* (2001) and Mohamed and Abdu (2004) on *Foeniculumvulgare.*

Tables(4 and 5) declared that the interaction between NPK fertilizer and biofertilization was significant on all growth parameters and yield. The superiority effect of applying 100% NPK plus interaction mixture of bio-fertilizerswas noticeable to plant height, number of braches/plant, fresh and dry weight,s (g)/plant, number of umbles, 100-seed weight, seed yield (g)/plant and seed yield (ton)/fed.

Table (2).Plant height, number of branches, fresh and dry weight,sas affected by some macroelement,sand bio-fertilization during 2013 /2014 and2014 / 2015 seasons.

Treatments	Plant height (cm)		Number of branches/plant		Fresh weight/plant(g)		Dry weight/plant (g)	
	2014	2015	2014	2015	2014	2015	2014	2015
A) NPKfertilizer								
Control	86.32d	92.33c	7.30c	7.97c	354.50d	385.42c	69.65d	79.43d
50% NPK	104.93c	112.75b	10.80b	12.00b	536.37c	681.41a	103.38c	119.60c
75% NPK	111.84b	119.79a	11.57a	12.87c	609.83b	657.7b	120.39b	131.18b
100% NPK	113.47a	121.28a	11.93a	13.20a	634.51a	681.83a	128.06a	138.14a
L.S.D.(0.05)	**1.10**	**1.05**	**0.50**	**0.60**	**10.70**	**12.30**	**2.90**	**3.20**
B) Bio-fertilization								
Uninoculation	96.26d	104.07d	8.13d	9.25d	400.27d	448.25e	83.44e	94.13d
Phosphorein	103.32c	110.25c	9.12c	10.79c	516.59c	584.19c	108.40c	118.63c
Cerealine	106.43b	114.61b	11.13b	12.33b	560.57b	605.58b	113.77b	123.88b
Potassmage	105.95b	113.74b	9.25c	10.38c	527.16c	567.80d	104.88d	114.88c
Mixed	108.80a	117.38a	13.58a	14.92	627.80a	675.79a	124.77a	134.78a
L.S.D.(0.05)	**1.20**	**1.30**	**0.70**	**0.85**	**11.20**	**12.60**	**3.10**	**4.60**
Interactions								
Ax B	*	*	*	*	*	*	*	*

Means of each factor designated by the same letter not significantly different at 5% using least Significant difference (L.S.D.)

*: Significant at 0.05 and 0.01 level of probability.

Table (3).Number of umbles, 100-seed weight, seed yield plant and seed yield fed as affected by some macroelement,s and bio-fertilization during 2013 /2014 and 2014 / 2015 seasons.

Treatments	Number of umblers/plant		100-seed weight (g)		Seed yield (g)/plant		Seed yield (ton)/fed	
	2014	2015	2014	2015	2014	2015	2014	2015
A) NPKfertilizer								
Control	104.43d	114.94d	1.45c	1.46c	73.40c	79.71d	0.880d	0.955d
50% NPK	157.07c	172.59c	1.55b	1.57b	82.51b	88.50c	0.967c	1.062c
75% NPK	175.97b	191.84b	1.58b	1.61b	89.66a	94.30b	1.064b	1.135b
100% NPK	180.05a	197.83a	1.62a	1.66a	90.37b	96.54a	1.085a	1.158a
L.S.D.(0.05)	**2.75**	**4.20**	**0.03**	**0.04**	**1.05**	**1.10**	**0.018**	**0.020**
B) Bio-fertilization								
Uninoculation	133.23e	134.79d	1.49d	1.51d	79.51e	85.11e	0.925e	1.021e
Phosphorein	144.59c	158.39c	1.52c	1.55c	80.58d	86.70d	0.967d	1.040d
Cerealine	164.66b	180.82b	1.56b	1.58bc	83.66c	89.07c	1.004c	1.071c
Potassmage	138.39d	153.57c	1.58ab	1.61ab	86.84b	91.88b	1.042b	1.102b
Mixed	201.16a	218.97a	1.60a	1.63a	88.12a	96.07a	1.057a	1.151a
L.S.D.(0.05)	**5.50**	**5.70**	**0.02**	**0.03**	**0.92**	**1.05**	**0.012**	**0.018**
Interactions								
Ax B	*	*	*	*	*	*	*	*

Means of each factor designated by the same letter not significantly different at 5% using least Significant difference (L.S.D.)
*: Significant at 0.05 and 0.01 level of probability.

Table (4). Interaction between NPK fertilizer and biofertilization on fresh and dry weights/plant during 2013 /2014 and 2014 /2015 seasons.

Treatments		Fresh weight (g)		Dry weight (g)	
NPK fertilizer	Bio-fertilization	2014	2015	2014	2015
Control	Uninoculation	311.20	343.44	57.87	67.33
	Phosphorein	354.47	381..64	71.17	81.50
	Cerealine	362.10	393.05	73.00	83.00
	Potassmage	339.47	366.90	67.40	76.60
	Mixed	405.33	439.06	78.83	88.70
50% NPK	Uninoculation	354.40	392.02	79.57	89.60
	Phosphorein	352.53	597.07	113.43	123.40
	Cerealine	568.13	615.64	116.00	127.00
	Potassmage	562.40	606.23	111.23	122.20
	Mixed	644.37	697.57	126.67	136.70
75% NPK	Uninoculation	473.87	513.23	95.17	105.20
	Phosphorein	614.93	644.44	119.83	129.90
	Cerealine	653.87	706.18	133.40	143.50
	Potassmage	592.67	636.50	116.10	126.40
	Mixed	708.80	768.13	140.47	150.60
100% NPK	Uninoculation	501.60	544.31	101.13	111.40
	Phosphorein	644.27	693.60	129.17	139.20
	Cerealine	658.14	707.46	132.67	142.70
	Potassmage	614.13	661.55	124.20	154.30
	Mixed	754.40	798.39	153.10	163.10
L.S.D.(0.05)		**11.80**	**12.20**	**3.70**	**4.90**

Table (5). Interaction between NPK fertilizer and biofertilization on 100-seed weight and seed yield during 2013/2014 and2014 / 2015 seasons.

Treatments		100-seed weight (g)		Seed yield (g)/plant	
NPK fertilizer	Bio-fertilization	2013/2014	2014/2015	2013/2014	2014/2015
Control	Uninoculation	1.40	1.42	70.31	75.73
	Phosphorein	1.44	1.45	70.55	77.03
	Cerealine	1.47	1.47	75.12	80.43
	Potassmage	1.47	1.48	76.88	82.07
	Mixed	1.48	1.50	73.83	83.30
50% NPK	Uninoculation	1.50	1.50	76.47	83.44
	Phosphorein	1.51	1.53	77.84	83.98
	Cerealine	1.57	1.58	80.39	86.84
	Potassmage	1.59	1.61	87.33	91.74
	Mixed	1.56	1.63	90.51	96.48
75% NPK	Uninoculation	1.51	1.5	84.62	89.39
	Phosphorein	1.55	1.58	85.63	91.44
	Cerealine	1.58	1.63	88.04	93.76
	Potassmage	1.60	1.65	91.18	96.56
	Mixed	1.65	1.66	92.83	100.35
100% NPK	Uninoculation	1.55	1.59	86.63	91.89
	Phosphorein	1.58	1.62	88.01	94.33
	Cerealine	1.60	1.65	91.10	95.23
	Potassmage	1.66	1.69	91.83	97.14
	Mixed	1.70	1.73	94.30	104.10
L.S.D.(0.05)		**0.03**	**0.04**	**1.30**	**1.45**

B) Total chlorophyll and Chemical composition

Data in Table (6) showed the effect of NPKfertilizer and biofertilization on total chlorophyll, N%, P% and K% in the leaves during the bothseasons.As for the effect of NPK fertilization obtained data showed that the treatment of 100 % NPK, gavethe highest total chlorophyll (1.864 and 1.378 (mg/g F.W.)N (2.29 and 2.33%), P (0.599 and 1.592%) andK(5.19 and 5.69%),for the both seasons respectively while theleasttotal chlorophyll, and N, P and K% were obtained from the control treatment during bothseasons. Results in Table (6) declared that thetotal chlorophylland chemical compositionincreased due to using all different commercial bio-fertilizers when compared to the uninoculation (control) treatment with significant differences in the most traits during both season. However, the highest mean values of chemical composition during both seasons were observed due to inoculation by the mixture biofertilizer. On the other hand, bio-fertilizers treatment resulted in the highest values of all studied parameters in comparison to the other treatments during both seasons. Hence, it could be concluded that these findings may be taken place due to that the active role of phosphorus, potassium dissolving bacteria and N-fixation (cerealine) and increasing the endogenous phytohormones as reported earlier which play an important rolesin life cycles of both shoot and root systems.

These obtained results are in compatible with those obtained by Kandeel *et al.* (2001) on *Foeniculum vulgare* and Osman (2000) on coriander. The interaction between NPKf ertilizer and biofertilization was significant on alltraits during both seasons (Table 7), whereas, theapplication of 100 % NPK and mixturebiofertilization on root zone of plant as result of adding fertilization treatments reflected positively on nutrients uptake by plants and confirm the previous vegetative growth. Similar results, more or less, were obtained by Aly (1994) on saponaria. Also, Jacoub (1999) on *Ocimum basilicum*, found that as all NPK rates increased; chemical compositionin the leaves and stem increased.

Table (6).Total chl. and N, P and K% as affected by some macroelements and bio-fertilization during during 2013/2014 and 2014 / 2015 seasons.

Treatments	Total chlorophyll (mg/g)		N%		P%		K%	
	2014	2015	2014	2015	2014	2015	2014	2015
A) NPKfertilizer								
Control	0.875d	0.884d	1.16d	1.21d	0.334d	0.352d	2.36d	3.05d
50% NPK	1.069c	1.079c	1.47c	1.49c	0.478c	0.465c	3.53c	3.91c
75% NPK	1.195b	1.207b	1.83b	1.88b	0.537b	0.531b	4.35b	4.81b
100% NPK	1.364a	1.378a	2.29a	2.33a	0.599a	0.592a	5.19a	5.69a
L.S.D.(0.05)	**0.080**	**0.087**	**0.20**	**0.25**	**0.055**	**0.057**	**0.45**	**0.40**
B) Bio-fertilization								
Uninoculation	1.017d	1.026d	1.44d	1.49d	0.402d	0.335d	3.52d	3.85c
Phosphorein	1.106c	1.117c	1.67c	1.69c	0.508b	0.542b	3.74cd	4.13b
Cerealine	1.176b	1.188b	1.80b	1.83b	0.485c	0.501b	3.99b	4.28b
Potassmage	1.076c	1.086c	1.67c	1.70c	0.445c	0.451c	4.29a	4.71a
Mixed	1.256a	1.267a	1.89a	1.92a	0.582a	0.583a	4.35a	4.84a
L.S.D.(0.05)	**0.075**	**0.072**	**0.07**	**0.07**	**0.060**	**0.065**	**0.22**	**0.19**
Interactions								
Ax B	*	*	*	*	*	*	*	*

Means of each factor designated by the same letter not significantly different at 5% using least Significant difference (L.S.D.)
*: Significant at 0.05 and 0.01 level of probability.

Table (7).Total chl. and N, P, and K% as effected by Interaction between NPK fertilizer and bio-fertilizer sources during 2013 / 2014 and 2014 /2015 seasons.

Treatments		Total Chlorophyll (mg/g F.W.)		N (%)		P (%)		K (%)	
NPK fertilizer	**Bio-fertilization**	**2013/2014**	**2014/2015**	**2013/2014**	**2014/2015**	**2013/2014**	**2014/2015**	**2013/2014**	**2014/2015**
Control	Uninoculation	0.765	0.772	1.00	1.08	0.247	0.267	2.30	2.50
	Phosphorein	0.852	0.861	1.14	1.16	0.354	0.401	2.59	2.94
	Cerealine	0.903	0.912	1.23	1.28	0.350	0.344	2.81	3.09
	Potassmage	0.827	0.837	1.21	1.21	0.317	0.340	3.00	3.30
	Mixed	1.028	1.034	1.24	1.29	0.400	0.407	3.10	3.40
50% NPK	Uninoculation	0.962	0..972	1.29	1.22	0.384	0.307	3.17	3.49
	Phosphorein	1.069	1.076	1.44	1.47	0.504	0.534	3.23	3.57
	Cerealine	1.134	1.147	1.54	1.57	0.477	0.490	3.36	3.68
	Potassmage	1.035	1.046	1.50	1.53	0.447	0.440	3.92	4.34
	Mixed	1.140	1.152	1.60	1.64	0.574	0.551	3.99	4.48
75% NPK	Uninoculation	1.108	1.118	1.56	1.62	0.480	0.354	3.82	4.18
	Phosphorein	1.183	1.197	1.81	1.85	0.544	0.587	4.09	4.48
	Cerealine	1.263	1.276	1.93	1.98	0.520	0.540	4.18	4.59
	Potassmage	1.153	1.161	1.72	1.80	0.494	0.474	4.81	5.35
	Mixed	1.266	1.282	2.12	2.18	0.644	0.647	4.83	5.42
100% NPK	Uninoculation	1.231	1.242	1.92	2.00	0.497	0.410	4.79	5.23
	Phosphorein	1.319	1.332	2.27	2.29	0.627	0.644	5.01	5.53
	Cerealine	1.401	1.417	2.46	2.48	0.590	0.627	5.27	5.74
	Potassmage	1.287	1.298	2.23	2.27	0.520	0.550	5.39	5.86
	Mixed	1.587	1.599	2.56	2.58	0.707	0.727	5.47	6.07
L.S.D.(0.05)		**0.084**	**0.090**	**0.29**	**0.30**	**0.064**	**0.068**	**0.48**	**0.43**

C) Major components percentage of essential oil

The effect of NPK fertilization treatments and biofertilization on essential oil of major components (Linalool, α-2-deenol, α- Pinene, Camphor and Geraniol) percentages are shown in Table (8). The recorded results indicated that using application 75 % NPKfertilization treatments had thehighest values for the studiedmajor components percentage of coriander oil in the sameTable. The interaction with potassiomage and mixture biofertilizer, brought about gave the highest percentage of major components in 2014 / 2015season.Similarresults were reported by Darzi *et al.* (2011) on anisum and Khalil (2008) on Foeniculum vulgare.

The highest values were produced by applied at 75 % NPK with inoculation of potassmage and mixed biofertilizer (Table8).

Table (8). Major components percentage as affected by mineral and bio-fertilization during 2014 /2015 seasons.

Treatments	Linalool%	α-2-deenol%	α-Pinene%	Camphor%	Geraniol%
A) NPK fertilizer					
Control	47.08d	13.47d	432c	5.19c	1.95
50% NPK	48.31b	15.00b	4.53b	5.54b	2.34
75% NPK	48.38a	15.10a	4.61a	5.87a	2.70
100% NPK	48.01e	14.89c	4.59a	5.88a	2.53
L.S.D.(0.05)	**0.05**	**0.06**	**0.04**	**0.06**	**0.06**
B) Bio-fertilization					
Uninoculation	47.95d	14.58b	4.49c	5.46d	2.20
Phosphorein	48.06c	14.56b	4.50bc	5.57c	2.35b
Cerealine	48.11bc	14.64a	4.52ab	5.64b	2.38
Potassmage	48.32a	14.65a	4.53a	5.69ab	2.50a
Mixed	48.14b	14.67a	4.54a	5.74a	2.49a
L.S.D.(0.05)	**0.06**	**0.05**	**0.02**	**0.05**	**0.04**
Interactions					
Ax B	*	*	*	*	*

Means of each factor designated by the same letter not significantly different at 5% using least Significant difference (L.S.D.)

*: Significant at 0.05 and 0.01 level of probability.

Table (9). Interaction between mineral fertilizer and bio-fertilization on major components percentage in 2014 / 2015 seasons.

NPK fertilizer	Bio-fertilization	Linolool	α-2-deenol	α-Pinene	camphor	Geraniol
Control	Uninoculation	47.08	13.46	4.30	5.02	1.85
	Phosphorein	47.11	13.47	4.30	5.11	1.94
	Cerealine	47.30	13.47	4.33	5.23	1.96
	Potassmage	47.20	13.48	4.34	5.31	2.01
	Mixed	47.50	13.47	4.33	5.30	2.00
50% NPK	Uninoculation	48.31	14.82	4.48	5.38	1.98
	Phosphorein	48.42	14.91	4.49	5.51	2.31
	Cerealine	48.48	15.02	4.53	5.51	2.38
	Potassmage	48.91	15.08	4.56	5.59	2.52
	Mixed	48.75	15.18	4.61	5.62	2.52
75% NPK	Uninoculation	48.38	15.11	4.59	5.63	2.45
	Phosphorein	48.41	15.03	4.61	5.73	2.60
	Cerealine	48.51	15.15	4.61	5.92	2.63
	Potassmage	48.83	15.11	4.63	5.95	2.91
	Mixed	48.61	15.11	4.62	6.14	2.89
100% NPK	Uninoculation	48.01	14.91	4.59	5.81	2.51
	Phosphorein	48.31	14.82	4.59	5.92	2.53
	Cerealine	48.32	14.89	4.60	5.91	2.53
	Potassmage	48.31	14.91	4.60	5.90	2.54
	Mixed	48.31	14.92	4.59	5.88	2.56
L.S.D.(0.05)		**0.05**	**0.06**	**0.04**	**0.05**	**0.05**

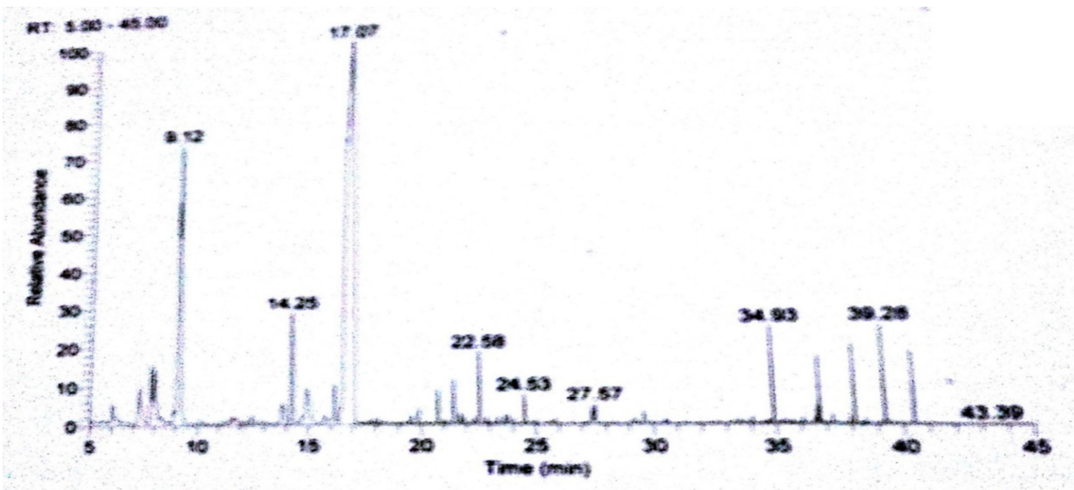

Fig (1). Typical chromatogram of Coriander oil

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الملخص العربي

تأثير التسميد ببعض العناصر الكبري والتسميد الحيوي علي النمو والمحصول والمحتوي الكيماوي لنبات الكزبرة

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**قسم بحوث النباتات الطبية والعطرية – مركز البحوث الزراعية – شعبة إنتاج وتكنولوجيا النباتات الطبية والعطرية

أجريت هذة الدراسة بمزرعة محطة النوبارية بالبحيرة– مصر خلال موسمي النمو ٢٠١٣/٢٠١٤، ٢٠١٤/ ٢٠١٥. وكان الهدف من هذه الدراسة هو دراسة تأثير التسميد المعدني والحيوي علي النمو الخضري والإنتاج والمكون الكيماوي والزيوت الفعالة وكذلك المكونات الرئيسية لنمو النبات ولذلك أقيمت تجربتان حقليتان لدراسة تأثير التسميد المعدني والحيوي علي النمو الخضري، المحصول، المكونات الكيميائية شاملة محتوي الزيت بالإضافة الي محتوي المكونات الفعالة للزيت لنبات الكزبرة. حيث صممت التجربة بتصميم القطع المنشقة مرة واحدة مع ثلاث مكرارت. وكان التسميد المعدني (كنترول، ٥٠% ن فو بو، ٧٥%ن فو بو، ١٠٠%ن فو بو) كقطع رئيسية، أما القطع الشقية فوزعت بخمس معاملات تسميد حيوي (بدون تلقيح، فوسفورين، سيريالين، بوتاسيوماج، خليط الأسمدة الحيوية) .

ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلي:

١. كان لإضافة التسميد المعدني عند ١٠٠% ن فو بو تأثيراً معنوياً علي صفات النمو الخضري، المحصول، المكونات الكيميائية مقارنة بالكنترول لنباتات الكزبرة في كلا الموسمين.

٢. كان أفضل تداخل بين إضافة١٠٠% ن فو بومع خليط الأسمدة الحيوية (فوسفورين، سيريالين، بوتاسيوماج) حيث أعطي أعلي متوسط قيم لإرتفاع النبات، عدد الأفرع/نبات، الوزن الطازج والجاف للعشب/نبات، عدد النورات/نبات، وزن ١٠٠ بذرة، محصول البذور/فدان إلي النسبة المئوية للزيت ولكن محتوي مكونات الزيت أنتجت من التداخل بين ٧٥% ن فو بو مع البوتاسيوماج وخليط من الأسمدة الحيوية لنبات الكزبرة ومع هذا فإن

الصفات تحت الدراسة زادت معنوياً عند معاملات التلقيح مقارنة بدون تلقيح (الكنترول) حيث أن خليط الأسمدة الحيوية كان أفضل معاملة .

٣. هذه الدراسة تقترح مزيد من الدراسة لتأثير معدلات التسميد المعدني والحيوي علي نبات الكزبرة تحت مختلف البيئات وبإسخدام أنواع مختلفة من الأراضي للحصول علي أقصي تداخل لأفضل إنتاج .