RESPONSE OF CORIANDER PLANTS TO ORGANIC AND MINERAL FERTILIZERS FERTIGATED IN SANDY SOILS

SALEM, AMAL G.[1] AND A. M. AWAD[2]

[1] *Aromatic and medicinal plants Res. Dept., Hort. Res. Institute, Alex. Hort. Res. St., ARC.*

[2] *Soil fertility and plant nutrition Res. Dept., Soils, Water and Environ. Res. Inst., Nubaria Agric. Res. Station, ARC .*

(Manuscript received 10 July 2004)

Abstract

The present investigation was conducted under conditions of newly reclaimed sandy soils irrigated using drip irrigation system at El-Bostan area, Nubaria region during the two successive winter seasons of 2001/02 and 2002/03. The trial was conducted to study the response of coriander plants (*Coriandrum sativum*, L.) to mineral fertilization (M.F.) as 5 combinations of nitrogen fertilizer (N) and micronutrients (M) foliary applied (Fe, Zn, and Mn) using two types of organic fertilizers (O.F.), farmyard manure (cattle, 10 m^3/fed) and chicken manure (chicken, 5 m^3/fed). Mineral fertilization (M.F.) treatments included control (without mineral fertilization), 30 kg N/fed (LN), 30 kg N/fed + micronutrients (LNM), 60 kg N/fed (HN), and 60 kg N/fed + micronutrients (HNM), all NP and K fertilizers were injected through irrigation system (fertigated) as ammonium nitrate (33.5 % N), phosphoric acid (85 % purity, 1.6 g/cm^3 density) and potassium sulph ate (48 – 50 % K_2O), respectively.

Generally, the obtained results indicated that, the different treatments improved the vegetative growth [plant height (PH), number of branches (BN)], yield and its components [number of umbels (UN), seed index (SI), fruit yield per plant and per feddan (FYP, FYF), essential oil percentage and oil yield per plant and per feddan (OYP, OYF) as compared to the control treatment (plants that were received only organic fertilizers)]. The best results for the previous parameters were obtained from the treatment of cattle manure + HNM followed by the treatment of chicken manure + LNM. Also coriander plants fruits concentration of N, P, K, Fe, Zn, and Mn nutrients were compared with the control treatment. N, P and K use efficiencies (UE) for seed and oil production were affected significantly by O.F. type and mineral fertilization treatments.

Fourteen components were identified in the coriander volatile oil by using Gas Chromatography-Mass Spectrum technique (GC-MS). These constituents differed in their percentage according to different treatments. Linalool was the major constituent, the highest values were obtained after adding cattle manure + HN followed by chicken manure + LNM, then cattle manure + HNM.

From the previous results we can concluded that by using sustainable agriculture roles under newly reclaimed land conditions, producing high yield with the same quality of organic farming products can achieved giving a chance to increase exportation from agricultural sector, and increase self sufficiency, nutritional status and care health of Egyptians.

INTRODUCTION

Coriander (*Coriandrum sativum*, L.) is an annual herb which belongs to family Apiaceae or Umbelliferae. It is indigenous to Italy, but is widely cultivated in Holland as well as central and eastern Europe, China, India, Bangladesh, and Mediterranean countries (Moroco, Malta and Egypt). In Egypt this crop widely grown in upper Egypt (Assiut and Minia governorates). The dried ripe fruits are brown and globular which contain up to 1% volatile oil. It is containing constituents like linalool (major constituents) and smaller amount of α-pinene, γ-terpinene, limonene and ρ-cymene together with various non-linalool alcohols and esters (William, 1989). Fresh leaves and dried fruits are used in culinary purposes. Medicinal use of fruits, on wide scale, is known in ointment for curing rheumatism and arthritis. Oil stimulates digestive secretions. In the USSR linalool is isolated from the oil as starting material for other derivatives.

In Egypt, large areas of newly reclaimed desert land have been cultivated with medicinal and aromatic plants using drip (trickle) and sprinkler irrigation during last few years. Such soils are suffering from insufficient organic matter contents as well as macro- and micro- nutrients. Organic fertilizers are used in order to compensate a part of the mineral fertilizers doses, taking in consideration the complementary or synergetic effect of such combination between organic and mineral fertilization. This could be of an economic value from the applied point of view of minimizing the used dose of the mineral fertilizers and consequently reduce agricultural costs as well as environmental pollution (Tate, 1989). Application of significant amount of organic manure to the soil has been a successful practice for improving the physical and chemical conditions as well as its productivity.

Several researchers have investigated the effect of organic fertilizers on several medicinal and aromatic plants, with the aim of determining the optimum fertilization treatments for maximum herb and oil production [El-Ghawwas *et al.* (2002) on *Foeniculum vulgare, Miller*, Osman (2000) on *Coriandrum sativum* L. and Taha (2002) on *Foeniculum vulgare* and *Coriandrum sativum* L.].

Nitrogen nutrition is one of the paramount factors which influence growth and reproductive development of plants. Nitrogen is very important in increasing the activity of the growing apex via increasing cell formation and elongation, as it is needed in the protoplasm formation.

Foliar application is particularly useful under conditions where nutrients uptake from the soil is restricted. This is often the case for the micronutrients such as Fe, Zn, Mn and Cu. Micronutrients play a very important role in vital processes of plants (Mortvedt *et al.,* 1991).

The interactions between organic fertilizer, mineral N and micronutrients were studied by Taha (2002) on *Foeniculum vulgare* Miller, and *Coriandrum sativum* L. He found that adding FYM (30 m^3/fed)+ Ammonium sulphate (300 kg/fed) + micronutrients (Fe, Zn and Mn) 200 L/fed at rate of 200 ppm of each element caused an increase in plant height, number of branches and umbels per plant, seed index, fruit yield per plant and essential oil content. Also he reported increases in nitrogen, phosphorus and potassium concentrations and uptake in fennel and coriander plants.

For the previous reasons, this investigation was conducted to evaluate the effect of two types of organic fertilizers (cattle and chicken manures) accompanied with two N levels (low and high) as well as absence and presence of foliar spray application of Fe, Zn, and Mn on the growth, oil yield, fertilizers use efficiency and chemical composition of an important Umbelliferae plant (*Coriandrm sativum,* L.). The results of this study may help in optimizing the herb and essential oil yields as well as the oil quality and the chemical composition of the plants under conditions of fertigated nutrients in sandy soils.

MATERIALS AND METHODS

Two field experiments were carried out during the two successive growth seasons of 2001/02 and 2002/03 at the experimental farm of South Tahrir Horticulture Research Station at Ali Moubarak village, El-Bostan area, Nubaria region. The experimental site belongs to the newly reclaimed sandy soils irrigated by the trickle irrigation system. The trial was conducted to study the response of coriander (*Coriandrum sativum,* L.) to mineral fertilization (M.F.) as 5 combinations of nitrogen (N) fertilizer and micronutrients foliar application under conditions of two types of organic fertilizers (O.F.), farmyard manure (cattle) and chicken manure (chicken). Mineral fertilization (M.F.) treatments included control (without mineral fertilization), 30 kg N/fed as low N fertilization rate (LN), 30 kg N/fed + micronutrients foliar application (LNM), 60 kg N/fed as high N fertilization rate (HN), and 60 kg N/fed +

micronutrients foliar application (HNM). Nitrogen was fertilized as ammonium nitrate (33.5 % N) and micronutrients mixtures contained chelated Fe, Zn and Mn with ratio (1:1:1) added as Fe-EDDHA (6 % Fe), Zn-EDTA (15 % Zn), Mn-EDTA (12 % Mn) sprayed with a rate of 300 g/300L water/fed using 600 liter motor sprayer. Organic fertilizers (O.F.) were incorporated under irrigation lines during land preparation with rates of 10 and 5 m^3/fed for cattle and chicken manures respectively.

A split-plot design with three replicates was used, assigning O.F. to the main plots and M.F. to the sub-plots. The O.F. was thoroughly incorporated in the soil 20 cm surface under drip irrigation lines which installed 80cm distances among irrigation lines. The coriander fruits were obtained from Medicinal and Aromatic Research Department, Horticulture Institute, ARC. Coriander fruits were sown on November 3rd and 6th in the first and second growing seasons respectively. Seeds were sown in holes at space of 25 cm in between, beside drip irrigation lines 3 - 4, seeds were sown in every hole. Thinning to 2 plants per hole was performed 30 days after sowing. The recommended dose of 15.5 kg P_2O_5/fed as phosphoric acid and potassium sulfate (24 kg K_2O/fed) were applied during the two growing seasons. Each N level was splitted into 18 equal doses. N dose was injected twice a week through the irrigation water (fertigation), every 3 days, using a hydraulic pump connected to the irrigation lines. P and K fertilizers orderly were fertigated with N fertilizer treatments through the 18 applications. The injection of N, P and K fertilizers through the irrigation water usually starts after 10 minutes from the beginning of the irrigation period and stops few minutes before the termination of irrigation to insure the washing of irrigation lines. Micronutrients spraying were applied 40 and 60 days after sowing during each growing season. All agromanagments necessary for coriander production were followed.

During land preparation surface soil samples were collected, dried, sieved prior to laboratory analysis (Page, 1982 and Klute, 1986). Some main soil physical and chemical characteristics were presented in Table 1.

Table 1. Some physical and chemical characteristics of the (experimental soils site at Ali Mubarak village.*

Characteristics	Growing season			
	2001/02		2002/03	
	0-20 cm	20-40 cm	0-20 cm	20-40 cm
Sand (%)	94.90	93.90	94.90	93.95
Soil texture class	Sand	Sand	Sand	Sand
FC (%)	13.30	10.70	13.20	10.50
PWP (%)	6.50	5.75	6.40	5.80
EC, dS/ m (Soil paste)	0.38	0.32	0.42	0.35
pH (1 : 2.5)	9.10	9.20	9.11	9.23
OM (%)	0.19	0.12	0.23	0.14
$CaCO_3$ (%)	5.21	5.40	5.23	5.20
$NO_3 + NH_4$ (mg/kg)	34.60	45.10	40.80	47.05
$NaHCO_3$-P (mg/kg)	9.44	5.52	10.20	6.10
Exch. K (mg/kg)	121.30	100.50	119.30	103.20
DTPA-Fe (mg/kg)	3.20	nd*	3.59	nd
DTPA-Zn (mg/kg)	1.02	nd	0.95	nd
DTPA-Mn (mg/kg)	2.62	nd	2.75	nd

* FC= field capacity, PWP= permanent wilting point and nd = not determined

Also samples of organic manure used during the two seasons were taken and subjected to laboratory analysis (Table 2).

Table 2. Some chemical and nutritional analysis of the applied cattle and chicken manures.

O.F. type	Growing season	pH	O.C.	O.M.	N	P	K	Fe	Zn	Mn	C/N ratio
			%					Mg/kg			
Cattle	2001/02	7.16	19.55	33.30	0.78	0.25	1.01	4200	142	321	25.00
	2002/03	7.23	20.49	34.90	0.76	0.26	1.10	4350	153	325	27.00
Chicken	2001/02	8.12	13.25	19.12	1.23	0.19	0.89	2480	112	128	10.77
	2002/03	8.17	14.39	21.06	1.24	0.18	0.91	2300	114	142	11.60

The coriander fruits were harvested before it was fully ripe, but sufficiently hard and greenish yellow in colour or semidry. Ten plants from each plot of coriander in each season were chosen randomly to study the growth parameters. The plants were cut off from the soil surface and left under shade place for about two weeks then, hammered for fruit separation. Data recorded were: plant height (cm), number of branches per plant, number of umbels per plant, fruits yield per plant, fruits yield per feddan, seed index, oil percentage, oil yield per plant, oil yield per feddan and essential oil constituents.

The essential oil percentage was determined in air dried fruits of coriander in both seasons as described by British pharmacopia (1968) then oil content (%) was calculated. Essential oil composition and changes in essential oil constituents of coriander as influenced by organic and mineral fertilizers were verified by using the Gas Chromatography-Mass Spectrum (GC-MS) Technique.

Conditions of GC-MS:

Information	Condition
Instrument	GC 5890 Mass spectrophotometer 5989, Hewlett Packared (HP)
Column	HP/5 30m × 0.25μm film thickens
Stationary phase	Polyphenyle methyl sioxane
Flow rate	0.6 ml Helium/min
Column temp.	50 - 200 °C
Rate temp.	6 °C min
Injection temp.	200 °C
Detected temp.	220 °C
Recorder	HP

The oil constituent's percentage was estimated from the measured peak area of the chromatograms according to Gunther and Joseph (1978).

Macro- (N, P and K) and micro-nutrients (Fe, Zn and Mn) were determined in coriander fruits. Samples were dried at 65 °C then ground and wet digested using H_2SO_4 and H_2O_2 (FAO, 1980). N, P and K concentrations were determined using Gerhard Vapodust 50 nitrogen distillation unit, spectrophotometer 21D and Jenway flame photometer, respectively. Fe, Zn, and Mn were measured using the atomic absorption spectrophotometer Perkin Elmer 3300 (Westerman, 1990).

Appropriate analyses of variance were performed for the two experiments using MSTAT-C software (Freed, 1988). Comparisons among means of the different treatments were carried out, using Duncan's multiple range tests as illustrated by Gomez and Gomez (1983).

RESULTS AND DISCUSSIONS

Experimental Site Characteristics

Soil analysis reflects the features of the experimental site, as a part of El-Bostan sandy soils area of 27,579 feddans (Table 1). Analysis for the surface and subsurface soil layers (0-20 and 20-40 cm) showed that no salinity hazard in the two growing seasons was recorded, the electrical conductivity (EC) ranged from 0.38 to 0.42 and from 0.32 to 0.35 dS/m, for the two growing seasons, respectively. Low levels of organic matter content were observed, whereas the soils are sandy with low calcareous content (about 94.9 % sand and 5.2 % $CaCO_3$). Also, Soil samples have low content of macro- (N, P and K) and micro- (Fe, Zn and Mn) nutrients in the two growing seasons (poor soils). The average of the field capacity and permanent wilting point values were around 13% and 6%, respectively indicating that there were relatively low quantity of available water for plants. Correspondingly, low fertility and insufficient water available for plant growth characterized the soil under consideration. Therefore modern irrigation systems were the dominant irrigation method in this area (71 %) whereas organic fertilizers are widely used in sandy soils at El-Nubaria region. Injecting mineral fertilizers throw irrigation systems (fertigation) has increasing attention with no good experience and without fertilization and irrigation programs.

Organic Fertilizers

Some main fertilizer characteristics of cattle and chicken manures used in the trial were presented in Table 2. The results indicated that cattle manure was rich in organic carbon (O. C.) and organic matter content. Total macronutrient content indicted that chicken manure was relatively rich in N than cattle manure which had wider C/N ratio, whereas P, K, Fe, Zn and Mn contents were higher in cattle manure than chicken manure reflecting higher supplying capacity with macro- and micro-nutrients. Application of significant amount of organic manures to the soil has been a successful practice for improving the physical and chemical conditions as well as its productivity (Tate, 1989).

I- Vegetative Growth Characteristics

I.1- Plant height (PH)

Data presented in Table 3 showed significant differences between the main effects of the two organic manures (cattle and chickens) with the mineral nitrogen, either at low or high level (LN or HN), in presence or absence the micronutrients (M) on the coriander plant height during the two experimental seasons.

Data revealed that application of the two types of tested organic manures significantly elongated the plants in all treatments of the two seasons of cultivation as compared to plants only organically fertilized (control treatment).

Figure 1 showed the average effect of the mineral fertilization treatments during the two growing seasons on the plant height. Generally, it can be noticed that, there was a gradual increase with gradual adding of the two levels of nitrogen and micro-nutrients.

The results recorded in Table 3 also showed that, the effect of interaction between cattle manure, high nitrogen and micro-nutrients (HNM) produced the highest plant heights (100.03 and 93.67 cm) in the first and second seasons, respectively. The chicken manure on the other hand gave the best result with low nitrogen and micro-nutrients (LNM) in both seasons (90.17 and 91.13 cm, respectively).

The enhancement may be due to the beneficial influence of organic manures on the soil and the role of nitrogen in the formation of new cells and cell elongation. Also the micronutrients (Fe, Zn and Mn) play important roles in vital processes of plants in addition to increasing use efficiency of other macro-nutrients.

Similar increases in plant height as a result of fertilization treatments have been reported by El-Ghawwas *et al.* (2002) on *Foeniculum vulgare, Miller*, El-sayed *et al.* (2003) on *Ocimum basilicum* L. and Taha (2002) on *Coriandrum sativum* L. Application of farmyard manure at a rate of 30 m^3/fed + micronutrients (Fe, Zn and Mn) 200 liter/fed at a rate of 200 ppm of each element + full or half dose of nitrogen fertilizer tremendously elongated the plant height by more than 44 % and 35.5 %, respectively compared with control.

I.2- Number of branches per plant (BN)

It is obvious from the data in Table 3 and Figure 1 that, in most cases, the different fertilization treatments significantly increased the number of branches per plant in the two seasons, compared to values obtained from control plants.

Table 3. Some plant characteristics of Coriander plants as affected by organic fertilizer type (O.F.) and mineral fertilization (M.F.) during the winter seasons of 2001/02 and 2002/03 under sandy soil conditions.*

Treatments		2001/02			2002/03		
O.F.	M.F.	PH (cm)	BN	UN	PH (cm)	BN	UN
Cattle	Control	78.0	9.3	82.7	75.4	10.0	78.3
	LN	89.1	10.7	93.3	81.6	11.0	92.0
	LNM	87.2	12.3	94.0	89.0	12.3	96.7
	HN	93.1	16.0	108.7	89.8	14.7	111.3
	HNM	100.0	15.7	113.0	93.7	16.3	111.7
	Mean	*89.5a*	*12.8a*	*97.9a*	*85.9a*	*12.9a*	*98.0a*
Chicken	Control	71.1	10.3	66.7	70.0	9.7	65.7
	LN	83.0	10.7	98.0	83.3	11.3	87.7
	LNM	90.2	13.0	114.3	91.1	11.7	109.3
	HN	77.2	9. 7	87.3	79.0	9.7	88.7
	HNM	79.9	11.3	95.3	82.1	11.0	91.7
	Mean	*80.3b*	*11. 0b*	*92.3b*	*81.1b*	*10.7b*	*88.6b*
LSD $_{0.05\ traetments}$		1.5	1.1	1.7	1.8	0.9	0.8

*O.F.= Organic fertilizers M.F.=Mineral fertilizers

PH= plant height (cm), BN= branches number/plant, UN= umbels number/plant, Control= without mineral fertilization, LN= low N, LNM= low N + micronutrients, HN= high N and HNM= high N + micronutrients.

Mean values having the same letter(s) are not significantly different ($LSD_{0.05}$).

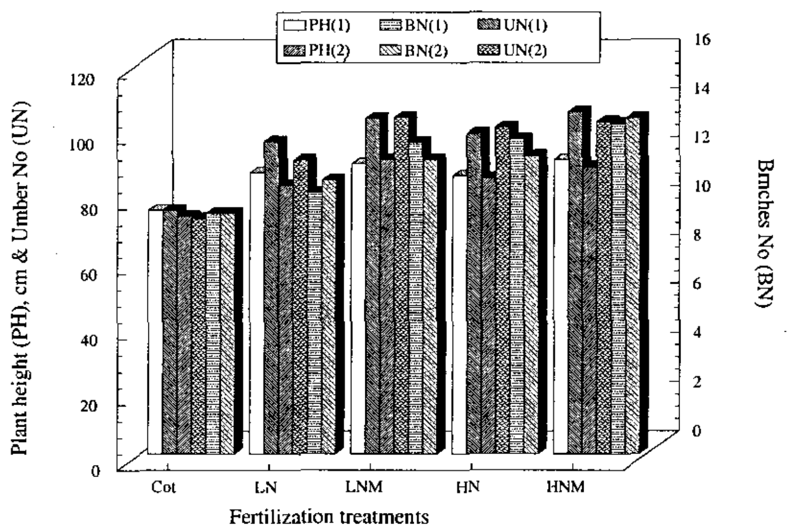

Figure 1. Some plant characteristics of Coriander plants as affected by mineral fertilization during first (1) and second (2) growing seasons (average values) under sandy soil conditions.

The highest number of branches was (16.3) due to applying cattle manure with HNM in the second season. Concerning the effect of chicken manure and its mixtures, the best result was (13.0) obtained after adding LNM in the first season.

These results were in agreement with those obtained by El-Ghadban (1998) on spearmint and marjoram, Osman (2000) on coriander, and Taha (2002) on fennel and coriander.

II- Yield and its Components

II.1- Number of umbels (UN)

The data in Table 3 and Figure 1 indicated that, the two types of organic manures with different mixtures of mineral fertilizers had a significant effect on the umbels number of coriander plants as compared to the plants received only organic manures (control treatment). These results were observed in the two seasons. The combined effect of the chicken manure, low nitrogen and micro-nutrients (LNM) gave the best results of umbels number (114.3) followed by cattle manure with (HNM) which produced an umbels number of 113.0. These results agreed with those obtained by El-Ghadban *et al.* (1998) on spearmint and marjoram, Osman (2000) on coriander and Taha (2002) on coriander. A promotion in the number of umbels was induced by application of farmyard manure, ammonium sulphate and micronutrients.

II.2- Seed index (SI)

Figure 2 and data presented in Table 4 revealed that, the two types of tested organic manure with different mixtures of mineral nitrogen and micronutrients significantly increased the seed index (weight of 1000 fruits) of coriander plants in both studied growing seasons. The highest figures of seed index (17.1, 18.8 gm per 1000 seed in the first and second season, respectively) were induced by the application of cattle manure combined with HNM.

Adding the chicken manure with LNM, on the other hand, produced the second highest values of seed index (17.0, 14.6 gm per 1000 seed in the first and second season, respectively). These results are in coincidence partially with the findings of Osman (2000) and Taha (2002) on coriander plants.

II.3- Fruit yield per plant and per feddan (FYP, FYF)

As might be expected, the effect of the applied treatments on the fruit yields per plant (FYP) and per feddan (FYF), (Figure. 2 and Table 4) were generally similar to

Table 4. Yield and some yield components of Coriander plants as affected by organic fertilizer type (O.F.) and mineral fertilization (M.F.) during the winter seasons of 2001/02 and 2002/03 under sandy soil conditions.*

Treatments		2001/02			2002/03		
O.F.	M.F.	FYP (g)	FYF (kg)	SI	FYP (g)	FYF (kg)	SI
Cattle	Control	36.1	722.6	11.9	35.7	713.4	10.4
	LN	43.7	873.4	12.7	40.1	802.4	10.9
	LNM	45.4	908.4	13.5	41.9	837.6	12.4
	HN	49.2	984.2	16.5	46.2	923.0	16.9
	HNM	52.4	1047.4	17.1	55.1	1101.4	18.8
	Mean	*45.4a*	*907.2a*	*14.4a*	*43.8a*	*875.6a*	*13.9a*
Chicken	Control	34.8	695.0	8.9	32.6	652.2	9.1
	LN	46.3	926.6	13.8	41.1	822.4	12.0
	LNM	51.6	1031.6	17.0	45.4	907.2	14.6
	HN	38.6	772.4	10.1	40.0	800.6	9.2
	HNM	42.0	840.0	10.9	40.9	818.6	11.0
	Mean	*42.7b*	*853.1b*	*12.2b*	*40.0b*	*800.0b*	*11.2b*
$LSD_{0.05\ traetments}$		0.90	27.31	0.33	0.48	0.38	17.44

*O.F. Organic fertilizers M.F.= Mineral fertilizers

FYP= fruits yield/plant, FYF= fruits yield/feddan, SI= seed index (weight of 1000 fruits, g),

Control= without mineral fertilization, LN= low N and LNM= low N + micronutrients, HN= high N and HNM= high N + micronutrients.

Mean values having the same letter(s) are not significantly different ($LSD_{0.05}$).

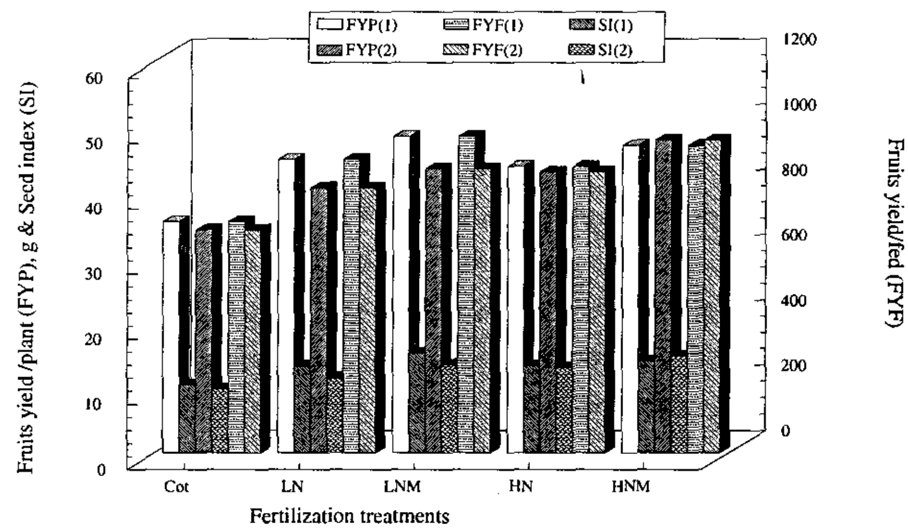

Figure 2. Yield and some yield components of Coriander plants as affected by mineral fertilization averaged over organic fertilization during first (1) and second (2) growing seasons under sandy soils conditions.

their effect on the other characteristics of coriander plant. Data clearly showed that, the coriander fruit yield per plant and per feddan were significantly increased following application of the different fertilization treatments. The cattle manure with HNM treatment continued to be the most effective one in the two seasons (52.4 and 55.1 gm per plant and 1047.4 and 1101.4 kg per feddan in the first and second seasons, respectively). The promotion in the fruit yield/ plant and yield/feddan induced by application of this treatment was more than 44 % and 54 % compared with the control treatment in the first and second seasons, respectively. On the contrary, the use of chicken manure with LNM came in the second place in terms of effectiveness, giving the second highest figures of fruit yield per plant and per feddan (51.6 and 45.4 gm per plant and 1031.6 and 907.2 kg /feddan), this represents about 48 % and 39 % increase more than control in the first and second season, respectively. These results are in accordance with El-Ghawwas *et al.* (2002) on fennel and Taha (2002) on coriander. Application of complete dose of N (ammonium sulfate at a rate of 300 kg/fed + farmyard manure (FYM) at 30 m^3/fed + micronutrients (Fe, Zn and Mn) 200 L/fed at rate of 200 ppm of each element, tremendously increased the fruit yield per plant and per feddan by more than double-fold in comparison with the control (plants unfertilized by mineral fertilizers). It is clear from all the previous results of vegetative growth and yield of coriander plants that, application of mineral nitrogen (at either low or high level) and micro-nutrients (Fe, Zn and Mn) with organic manure either cattle or chicken caused increases in most treatments as comparing with the control. These results may be due to: firstly, the beneficial effect of organic manure which improves the growth and quality of the product through effective role of the organic fertilizers in improving the properties of soil and providing the plants with nutrients elements including macro and micro elements which are essential to plant (Awad *et al.*, 1993). Moreover, the addition of manures to the sandy soil increases the soil's water-holding capacity which, in turn, allows higher absorption of water and nutrients from the soil, and enables photosynthesis to occur efficiently within the plant leaves (Hartman *et al.*, 1981), secondly, The efficiency of using the mineral nitrogen fertilizer in easier form in the upper surface of soil, and could be absorbed by the roots of coriander. Nitrogen is present in the structure of protein molecules, Thirdly, The important roles could be played by the micronutrients (Fe, Zn and Mn) in the different physiological and biochemical processes within the plant.

Generally, the superior effect of cattle manure with the different mixtures on vegetative growth and yield of coriander compared to the chicken manure with its different mixtures can be noticed. This may be attributed to their different composition of each of them. The cattle manure with its different mixtures, generally, caused gradual increases in the different treatments to reach the maximum with HNM which was the superior due to the beneficial effect on cycling nutrients, increase holding irrigation water, supplying microorganisms with their needs (Smith and Sharply, 1990 and Carpenter-Bogges, 2000). LNM, on the other hand, was the best one with chicken manure in the most parameters of vegetative growth and coriander yield due to high N content which is reflected in the narrow C/N ratio (Table 2). Chicken manure with HN and HNM caused decreases in most of coriander characteristics as compared to other treatments in the two experimental seasons. This may be attributed to the relatively high concentration of nitrogen in the chicken's manure which released directly during the fast decomposition. Thus, when the mineral nitrogen is used at the high rate, this may lead to an excessive increase in the concentration of nitrogen salts in the soil solution, which may cause partial plasmolysis of root cells, and an adverse effect on their ability to uptake water and nutrients.

In contrast, the application of high nitrogen dose with the cattle manure which has lower content of nitrogen was associated with increases in the recorded values, up to the highest when adding micro-nutrients.

III- Chemical Composition Of Coriander Plant

III.1- Essential oil production

III.1.a- Essential oil percentage (EO)

It is evident from the data of Fig. (3) and Table (5) that in the most cases percentage of coriander essential oil significantly increased by application of the two studied types of organic manures combined with the two levels of mineral nitrogen as well as micronutrients during both seasons compared to those of plants unfertilized by mineral fertilizers (control). In the first season, there were significant differences among all treatments treated by either cattle or chicken manure. In the second season, the differences between LN and LNM and LNM and HN with the cattle manure treatments did not reach the level 5 % of significance. Also there were insignificant differences between LN and LNM and between HN and HNM with chicken manure treatments during the second season. The most pronounced increases in coriander oil percentage were obtained after adding the cattle manure combined with

HNM in the both seasons. The results recorded in this regard was (0.720 % and 0.813 %) in the first and second season, respectively. The chicken manure, on the other hand, gave the second highest oil percentages of 0.612 % and 0.584 % when it was applied with LNM in the first and second season, respectively. The obtained results are in the same line with those reported by El-Sayed *et al.* (2003) on *Ocimum basilicum* L. Osman (2000) and Taha (2002) on *Coriandrum sativum* L. Taha (2002) mentioned that, the oil percentage of coriander increased by more than three-fold compared with control after

Table 5. Essential oil percentage and oil yields of Coriander plants as affected by organic fertilizer type (O.F.) and mineral fertilization (M.F.) during the winter seasons of 2001/02 and 2002/03 under sandy soil conditions.*

Treatments		2001/02			2002/03		
O.F.	M.F.	EO (%)	OYP (ml)	OYF (L)	EO (%)	OYP (ml)	OYF (L)
Cattle	Control	0.299	0.108	2.160	0.320	0.114	2.280
	LN	0.553	0.241	4.820	0.630	0.253	5.060
	LNM	0.527	0.239	4.780	0.639	0.268	5.360
	HN	0.675	0.332	6.640	0.646	0.298	5.960
	HNM	0.720	0.377	7.540	0.813	0.448	8.960
	Mean	*0.555a*	*0.260a*	*5.193a*	*0.610a*	*0.276a*	*5.526a*
Chicken	Control	0.272	0.095	1.900	0.255	0.083	1.660
	LN	0.530	0.246	4.920	0.563	0.232	4.640
	LNM	0.612	0.316	6.320	0.584	0.265	5.300
	HN	0.510	0.197	3.940	0.490	0.196	3.920
	HNM	0.572	0.240	4.800	0.515	0.211	4.220
	Mean	*0.499b*	*0.219b*	*4.374b*	*0.481b*	*0.197b*	*3.948b*
LSD 0.05traetments		0.02	0.01	0.23	0.03	0.01	0.28

* O.F. = Organic fertilizers M.F. = Mineral fertilizers

EO= Essential oil percentage, OYP= oil yield /plant, OYF= oil yield /feddan.

Control= without mineral fertilization, LN= low N, LNM= low N + micronutrients, HN= high N and HNM= high N + micronutrients.

Mean values having the same letter(s) are not significantly different ($LSD_{0.05}$).

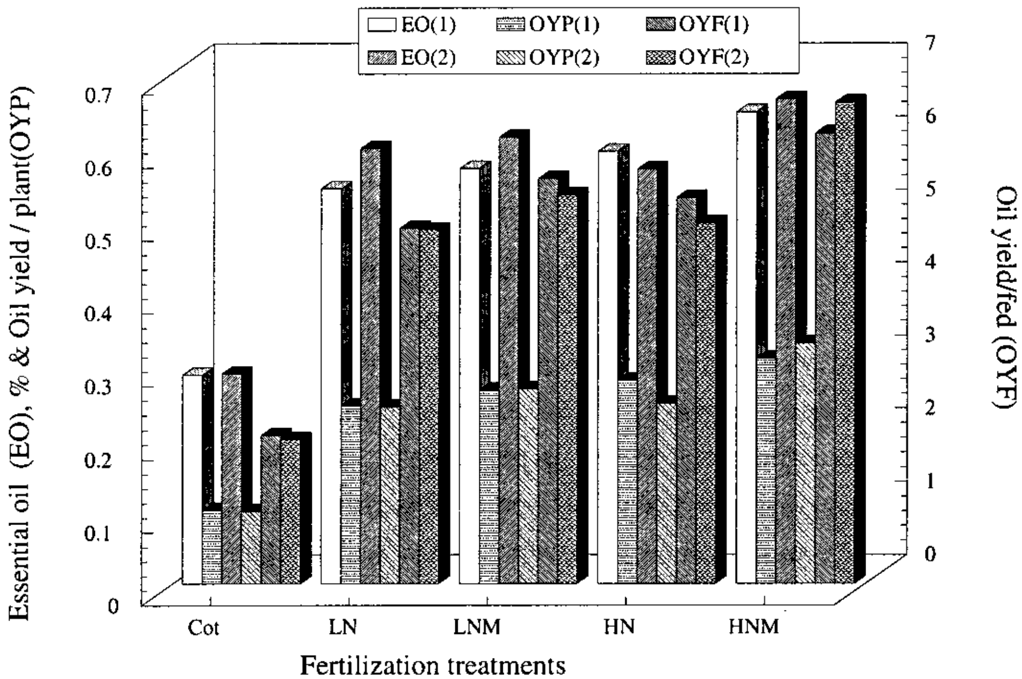

Figure 3. Essential oil percentage and oil yields of Coriander plants as affected by mineral fertilization averaged over organic fertilization during first (1) and second (2) growing seasons under sandy soil conditions.

using the combination of organic manure + mineral nitrogen + micro-nutrients.

III.1.b- Oil yield per plant and per feddan (OYP, OYF)

Table 5 and Figure 3 explicated that, the oil yield per plant (OYP) and per feddan (OYF) of coriander plants significantly enhanced by application of all treatments in both growing seasons. It is clear from the results that, there were significant differences among all treatments, exception being only obtained between LN and LNM in combination with cattle manure during the first season. As might be expected, the highest value of oil yield per plant and per feddan was produced after supplying the plants with cattle manure with HNM followed by LNM with chicken manure. The results were 0.377 and 0.448 ml per plant and 7.540 and 8.960 L per feddan after adding cattle manure + HNM in the first and second season, respectively. The values were 0.316 and 0.265 ml per plant 6.320, 5.300 L per feddan by application the chicken manure + LNM in the first and second seasons, respectively.The above results are in agreement with those obtained by El-Sayed *et al.* (2003) on *Ocimum basilicum* L. and Taha (2002) on *Coriandrum sativum* L. Application of complete dose of N and organic manure tremendously increased the oil yield per plant and per feddan by more than four-fold compared with the control. The obtained results of coriander oil content emphasized the beneficial role of the application of organic manures as well as mineral fertilizers on the metabolic process induced in plant which responsible about the quantity and quality of essential oil content of coriander plant.

III.1.c- Essential oil components

Data presented in Table 6 and illustrated in Figures 4a and 4b showed that there were 14 components identified in the coriander essential oil by using Gas chromatography mass spectrum technique (GC-MS). They were α-pinene, β-pinene, ρ-cymene, limonene, δ-terpinene, linalool, camphor, borneol, 4-terpineol, α-terpineol, citronellol, levocarvone, geraniol, and geranyl acetate. The results clearly showed that, linalool was the major principal constituent of coriander oil and affects its quality. It could be seen from the previous data that, all the applied treatments improved the linalool content compared with the control, with the exception of chicken manure treatment with HN and HNM. Application of cattle manure with HN was the most effective treatment in increasing the linalool content. Oil extracted from plants receiving this treatment had the highest linalool content (89.7%) followed by plants fertilized with chicken manure with LNM (which gave a linalool content of 89.4 %).

Table 6. Oil constituents of coriander plants as affected by organic fertilizer type (O.F.) and mineral fertilization (M.F.) during the winter season of 2002-2003.

Treatments O.F.	M.F.	α-pinene	β-pinene	ρ-cymene	limonen	δ-terpinene	linalool	camphor	borneol	4-terpineol	α-terpineol	citron-ellol	Levo-carvone	geraniol	geranyl acetate
Cattle	Control	0.45	0.00	0.56	0.43	2.15	87.39	2.16	0.31	0.25	0.56	0.00	0.20	1.16	1.28
	LN	0.42	0.20	0.33	0.47	1.11	88.18	1.95	0.00	0.18	0.61	0.14	0.00	2.02	2.65
	LNM	0.51	0.15	0.41	0.62	2.17	87.75	2.04	0.48	0.00	0.49	0.09	0.00	1.88	2.50
	HN	0.80	0.07	0.58	0.51	2.24	89.86	1.26	0.42	0.20	0.53	0.00	0.18	1.40	1.32
	HNM	0.77	0.22	0.64	0.45	2.31	89.32	1.24	0.31	0.00	0.52	0.00	0.00	1.95	1.76
	Mean	0.59 a	0.13 a	0.52 b	0.30 a	2.00 a	88.50a	1.73 a	0.30 a	0.126 b	0.54 a	0.04 a	0.08 a	1.68 a	1.90 a
Chicken	Control	0.38	0.14	1.02	0.35	2.04	84.53	1.33	0.45	0.00	0.39	0.00	0.40	1.14	2.13
	LN	0.47	0.18	1.13	0.22	2.57	87.29	2.41	0.41	0.32	0.00	0.10	0.42	1.35	1.06
	LNM	0.59	0.19	1.30	0.18	1.35	89.43	1.73	0.49	0.42	0.18	0.00	0.11	1.82	1.18
	HN	0.55	0.00	1.07	0.39	1.62	76.74	1.17	0.35	0.23	0.22	0.04	0.00	0.00	2.35
	HNM	0.62	0.10	0.98	0.14	2.35	78.69	2.20	0.00	0.18	0.29	0.12	0.35	0.00	2.02
	Mean	0.52 b	0.12 a	1.10 a	0.26 a	1.99 a	83.34b	1.77 a	0.34 a	0.23 a	0.22 b	0.05 a	0.26 b	0.86 b	1.75 b
LSD 0.05traet.		0.048	0.026	0.072	0.031	0.180	2.153	0.157	0.025	0.031	0.033	0.020	0.055	0.119	0.148

Mean values having the same letter (s) are not significantly different ($LSD_{0.05}$).

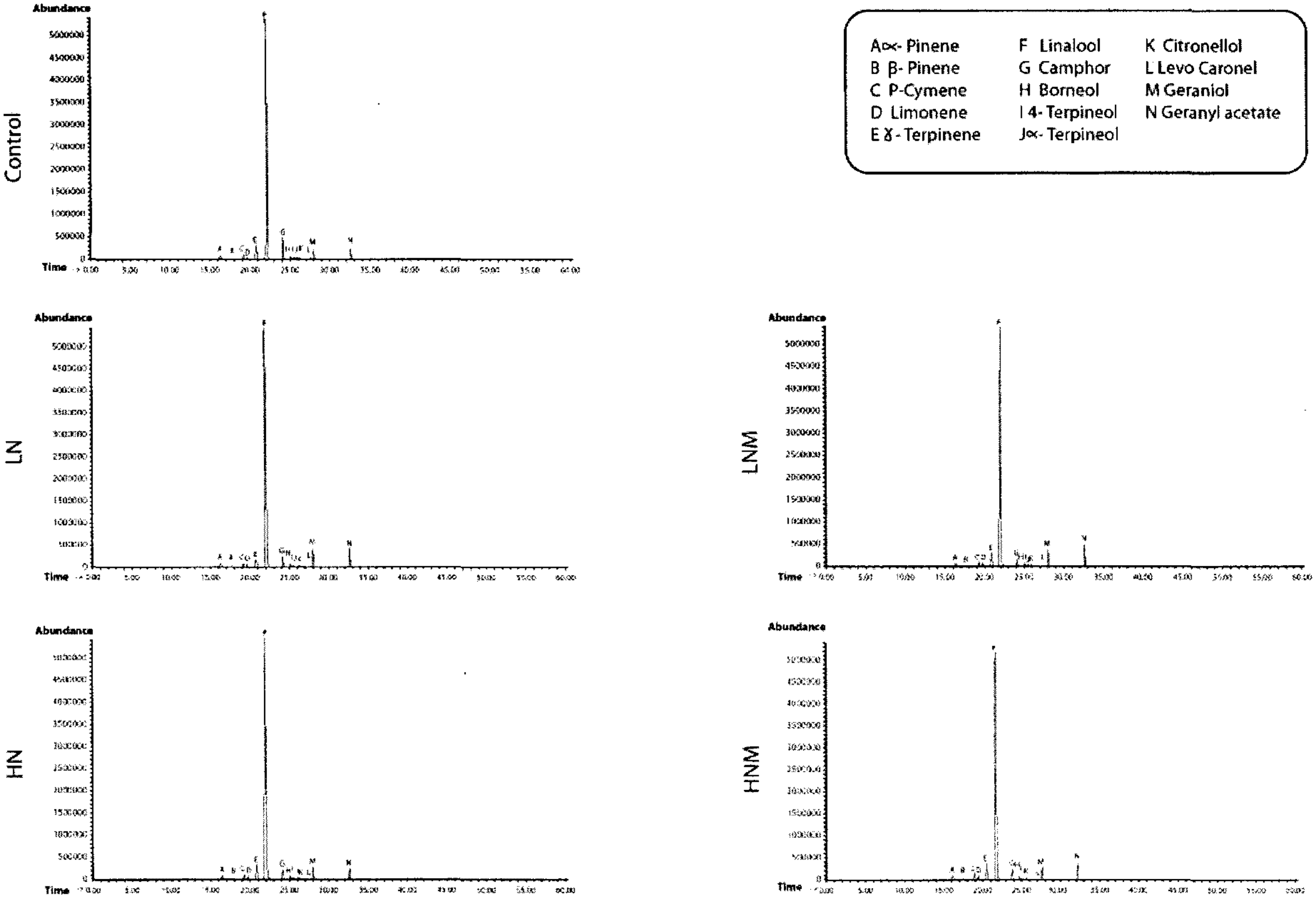

Fig. 4a. Chromatogram of Coriander oil constituents as affected by cattle manure and mineral Fertilization (M.F.) in 2002/2003 growing season. (Control= without M.F.; LN= low N; LNM= low N+ micronutrients; HN= high N; HNM= high N+ micronutrients)

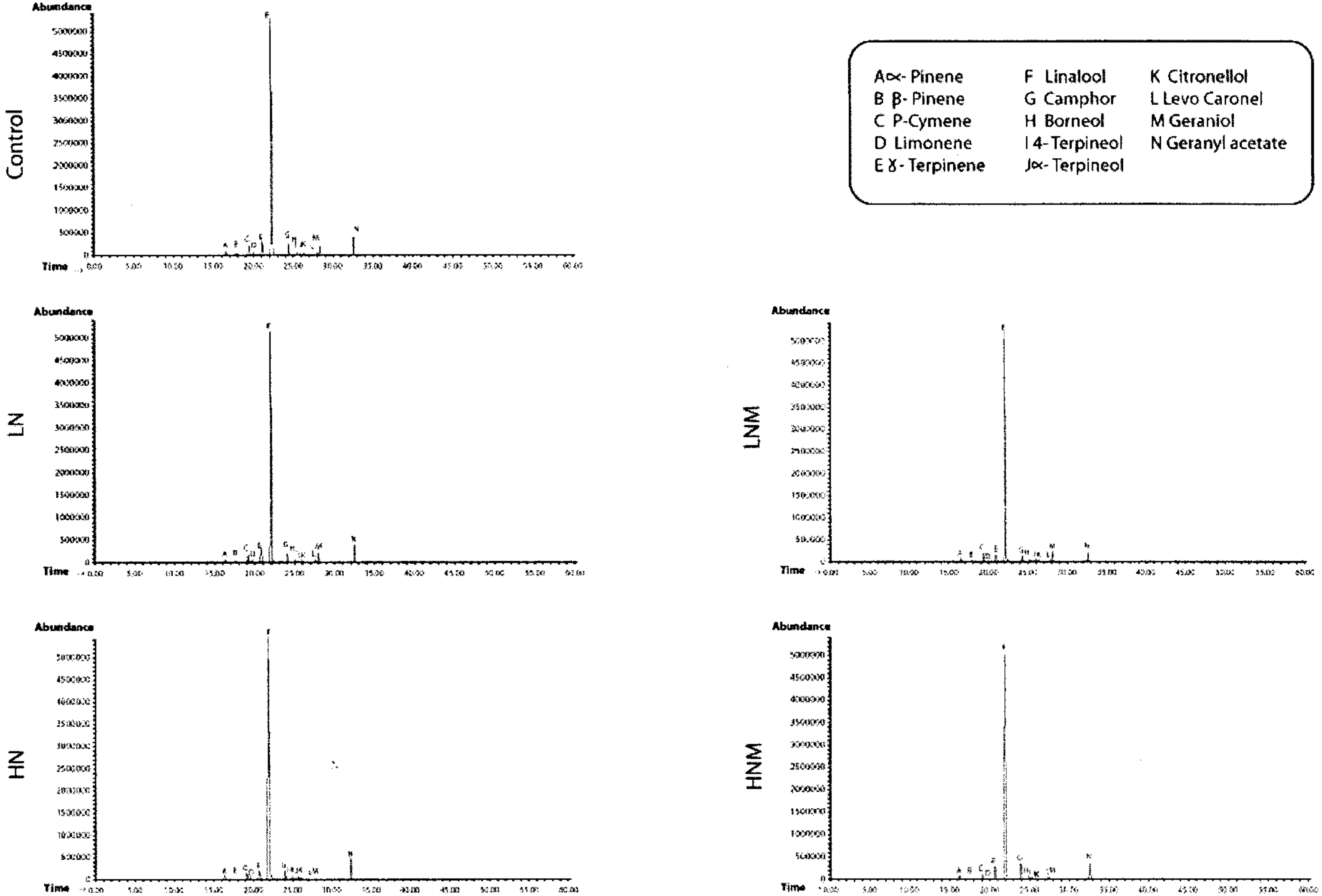

Fig. 4b. Chromatogram of Coriander oil constituents as affected by chicken manure and mineral Fertilization (M.F.) in 2002/2003 growing season. (Control= without M.F.; LN= low N; LNM= low N+ micronutrients; HN= high N; HNM= high N+ micronutrients)

The fertilization using cattle manure + HNM came in the third place in terms of effectiveness, giving the third highest linalool percentage (89.32 %). Similar increases in linalool percentage in coriander plants as a result of fertilization using organic manure + mineral N + (Fe, Zn and Mn) have been reported by Taha (2002).

Components as α-pinene, β-pinene, ρ-cymene, limonene, and δ-terpinene were identified as monoterpen hydrocarbons. The average of these constituents represented about 2.5 %, while the average of the rest (8 components) represented about 5.3 %. In general, there were significant differences between the control and other treatments in most constituents and the results differed according to different components. Some components increased with gradual adding of mineral fertilizers (combinations of N and micronutrients) and others decreased. Also it can be noticed that some constituents disappeared in some treatments.

Generally, it is clear from the previous results that the application of mineral nitrogen and micronutrients with organic manures proved beneficial for coriander essential oil quality. It is, therefore, worthy of consideration that supplemental mineral fertilizers with organic fertilizers could be explained to farmers for producing high quality essential oil from coriander fruits.

The obtained results are in agreement with those obtained by El-Ghadban *et al.* (1998) on spearmint and marjoram, Osman (2000) on coriander and Taha (2002) on fennel and coriander.

III.2- Macro- and Micro-nutrients Contents

There is a tremendous concern to produce medicinal and aromatic plants in the newly reclaimed lands because of favorable environmental conditions, but nutrients low availability ceases increasing growing areas due to decreasing products quality which decreases the chance to exportation.

Growing Coriander plants under nutrients imbalance, may reduce quality and affecting productivity. Under newly reclaimed sandy soils conditions applying all convenient practices, including injecting nutrients throw irrigation system and /or applying foliar fertilization, to increase supplying macro- and micronutrients concentrations to near optimum level should induce good vegetative growth and performance causing increases in both fruits yield and quality including oil content and constituents.

Results depicted in Table 7 and Figure 5 pointed out that N, P and K concentrations in coriander fruits were affected positively and sometimes significantly due to type of manure and combination of mineral N level and micronutrients foliar application. Main effect of organic fertilizer demonstrates insignificant N, P and K concentrations. Figure 5 showed the average effect of the mineral fertilization

Table 7. Macronutrients concentrations of Coriander plant fruits as affected by organic fertilizer type (O.F.) and mineral fertilization (M.F.) during the winter seasons of 2001/02 and 2002/03 under sandy soil conditions.*

Treatments		2001/02			2002/03		
O.F.	M.F.	N	P	K	N	P	K
		%			%		
Cattle	Control	2.29	1.80	1.02	2.31	1.77	1.16
	LN	3.01	1.77	1.35	2.83	1.78	1.27
	LNM	2.70	1.84	1.21	2.76	1.81	1.28
	HN	2.90	1.94	1.08	2.89	1.85	1.19
	HNM	2.89	1.73	1.47	2.87	1.78	1.33
	Mean	*2.75b*	*1.82a*	*1.25a*	*2.73a*	*1.80a*	*1.26a*
Chicken	Control	2.67	1.81	1.27	2.41	1.77	1.29
	LN	2.66	1.79	1.33	2.59	1.80	1.32
	LNM	2.94	1.88	1.14	2.72	1.85	1.24
	HN	2.88	1.86	1.09	2.78	1.80	1.13
	HNM	2.99	1.89	1.18	2.89	1.85	1.20
	Mean	*2.83a*	*1.85a*	*1.20a*	*2.68a*	*1.81a*	*1.24a*
$LSD_{0.05 traetments}$		0.09	0.05	0.39	0.13	0.07	0.07

* O.F. = Organic fertilizers M.F. = Mineral fertilizers

EO= Essential oil percentage, OYP= oil yield /plant, OYF= oil yield /faddan.

Control= without mineral fertilization, LN= low N, LNM= low N + micronutrients, HN= high N, HNM= high N + micronutrients.

Mean values having the same letter(s) are not significantly different ($LSD_{0.05}$).

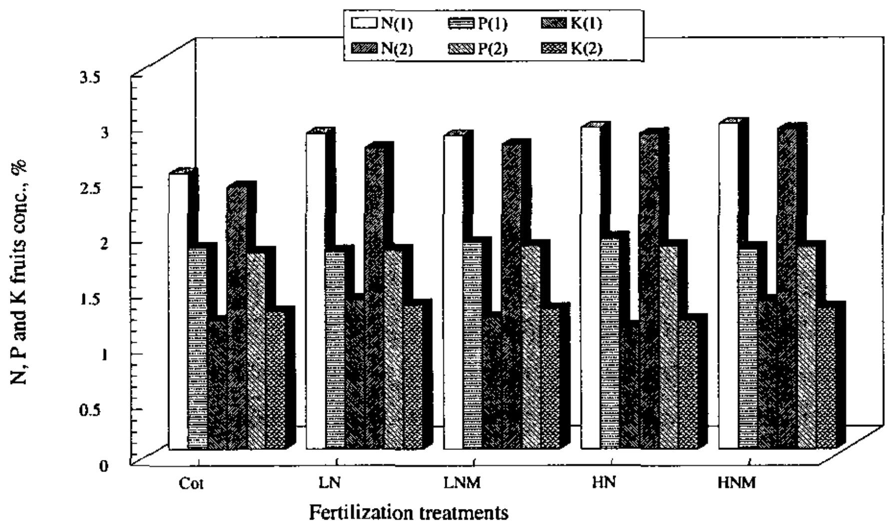

Figure 5. Nitrogen, phosphorus and potassium concentrations in Coriander fruits as affected by mineral fertilization during first (1) and second (2) growing seasons under sandy soil conditions.

treatments over the two growing seasons. Generally, progressive increases can be noticed with increasing the levels of both N and micro-nutrients. It can be concluded that applying micronutrients, as foliar spray, increased NP and K concentrations in leaves and cloves of garlic plants grown under sandy soils conditions (Hegazi *et al.,* 2002).

The results depicted in Table 7 also showed that, combined effect (interaction) of chicken manure, and mineral nutrition in treatment (HNM) gives the highest fruits N concentration (2.99 - 2.89 %) in both first and second seasons, respectively. The N concentration for cattle manure + (HNM) treatment differs significantly from most of the other treatments, values being 2.89 and 2.87 % in both seasons, respectively. Opposite trend of data for both P and K was demonstrated, cattle manure being significantly higher than chicken manure. From data of fruit yield per plant and per feddan (FYP and FYF) (Table 4), can noticed that, increasing N concentration in chicken manure + HNM treatment, without adequate PK supply did not translate to highest coriander fruit yield. On the contrary, the use of chicken manure with LNM came in the second place after cattle manure + (HNM) treatment in terms of effectiveness, giving the second highest fruit yield per plant and per feddan.

Foliar application is particularly useful under conditions where nutrient uptake from the soil is unavailable. This is often the case for the micronutrients such as Fe, Zn and Mn. These nutrients are frequently retained or fixed by soil particles and for this reason are scarcely available to plant roots. Data presented in Table 8 and Figure 6 show main and interaction effects of the tested treatments on coriander fruits Fe, Zn and Mn concentrations. Fe concentration was affected significantly with organic fertilizer type, it increased in case of applying cattle manure than that of chicken manure. Concentrations of Zn and Mn, on the other hand, were not affected significantly by organic fertilizer type. Manures analysis (Table 2) showed a notable concentration of Fe in cattle manure, compared to than chicken manure, while Zn and Mn concentrations were approximately similar in the two manures. Foliar application in the form of either inorganic salts or chelates is a valuable tool in combating nutrient deficiencies (Tukey *et al.,* 1962). As micronutrients are only required in small quantities, foliar spray applied once or twice and correctly timed, is adequate to meet the demand of the crop (Cooke, 1975).

Table 8. Micronutrients concentration of Coriander plants fruits as affected by organic fertilizer type (O.F.) and mineral fertilization (M.F.) during the winter seasons of 2001/02 and 2002/03 under sandy soils conditions.*

Treatments		2001/02			2002/03		
O.F.	M.F.	Fe	Zn	Mn	Fe	Zn	Mn
		µg/g			µg/g		
Cattle	Control	564.0	75.0	58.2	540.0	69.9	61.0
	LN	412.7	61.0	34.7	518.0	61.2	53.2
	LNM	428.0	65.3	38.7	689.7	62.3	53.9
	HN	390.0	59.3	38.7	500.0	62.0	53.1
	HNM	484.0	60.7	40.0	532.3	64.2	48.5
	Mean	*455.7b*	*64.3a*	*42.0a*	*555.9a*	*64.1a*	*53.9a*
Chicken	Control	530.0	62.7	50.2	534.2	60.9	53.0
	LN	365.0	65.1	40.5	390.0	63.1	50.7
	LNM	450.0	67.1	44.3	414.0	65.0	42.1
	HN	407.5	61.0	35.2	470.3	67.0	41.3
	HNM	468.5	64.0	40.3	518.2	65.4	37.3
	Mean	*444.2a*	*64.0a*	*42.1a*	*461.0b*	*64.3a*	*44.9b*
$LSD_{0.05 traetments}$		86.83	4.03	9.30	9.90	1.90	1.50

* O.F. = Organic fertilizers M.F. = Mineral fertilizers

EO= Essential oil percentage, OYP= oil yield /plant, OYF= oil yield /faddan.

Control= without mineral fertilization, LN= low N, LNM= low N + micronutrients, HN= high N, HNM= high N + micronutrients

Mean values having the same letter(s) are not significantly different bases to $LSD_{0.05}$.

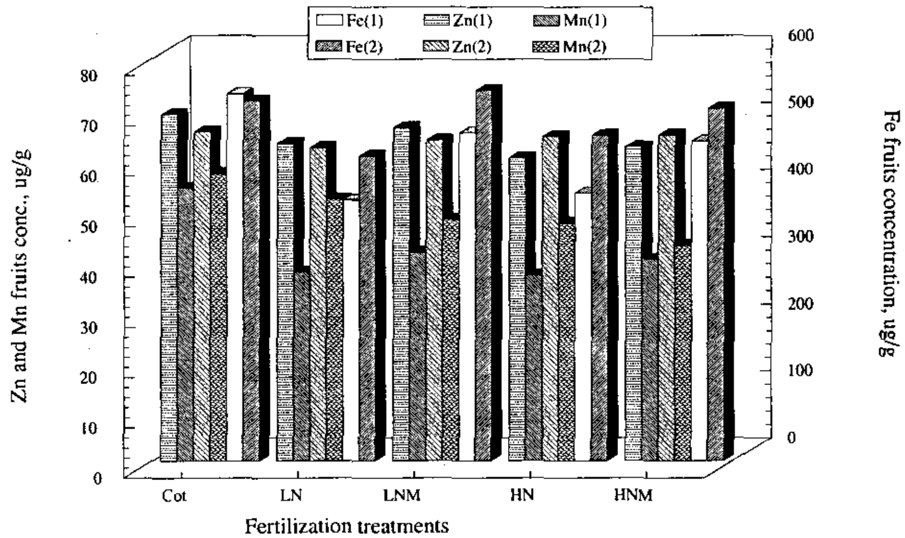

Figure 6. Iron zinc and manganese concentration of Coriander fruits as affected by mineral fertilization during first (1) and second (2) growing seasons under sandy soil conditions.

Commonly, it is clear from the previous results that, the fertilization with of mineral nitrogen and micronutrients with organic manures establish beneficial effects for coriander plants growth, yields and essential oil quality. It is, consequently, worthy of deliberation that supplemental mineral fertilizers fertigated through irrigation lines with organic fertilizers could be recommended for farmer as sustainable treatments for producing high quality medicinal and aromatic plants for herbal and essential oils production under newly reclaimed soils conditions.

III.3- Fertilizers Use Efficiencies

Fertilizing without economical production means lowering farm profitability and missing of resources, all farmers aimed to increase productivity from each added fertilizer unit. Figures 7 and 8 show N, P and K fertilizers use efficiencies for coriander fruits production (UEfru = Fruit yield/fed ÷ fertilizer units/fed) and for coriander oil production (UEoil = oil yield/fed ÷ fertilizer units/fed), respectively.

The results indicated that increasing N fertilization rate from 30 to 60 kg N/fed decreased the two types of N use efficiency (NUEfru and NUEoil). Cattle manure data indicated that fruits and oil production reached higher levels (17.9kg fruits / kg N fertilizer and 0.138 liter/kg N fertilizer) than chicken manure under high N level mixed with micronutrients (HNM) (13.8 kg fruits/kg N fertilizer and 0.075 liter/kg N fertilizer). On the other hand, under low N level (LNM), chicken manure presented higher UE values (32.3 fruits/kg N fertilizer and 0.194 liter/kg N fertilizer) compared to treatment (HNM). These results may be due to characteristics of chicken manure which was relatively rich in N than cattle manure which had wider C/N ratio.

Different trend of data were observed for P and K fertilizers use efficiencies (PUE and KUE). The results indicated that for cattle manure the two types of PUE and KUE generally increased gradually with increasing N level and spraying micronutrients, whereas for chicken manure the values were lower than that for cattle manure and decreased with increasing N level. Generally, the data reflected the more effects for cattle manure, within the different mixtures, on fruits and oil yields of coriander compared to the chicken manure within its different mixtures. This may be attributed to their different composition (Table 2). The enhancement effect of cattle manure in increasing availability of P and supplying K under newly reclaimed lands conditions are well documented (Cooke, 1975 and Tate, 1989).

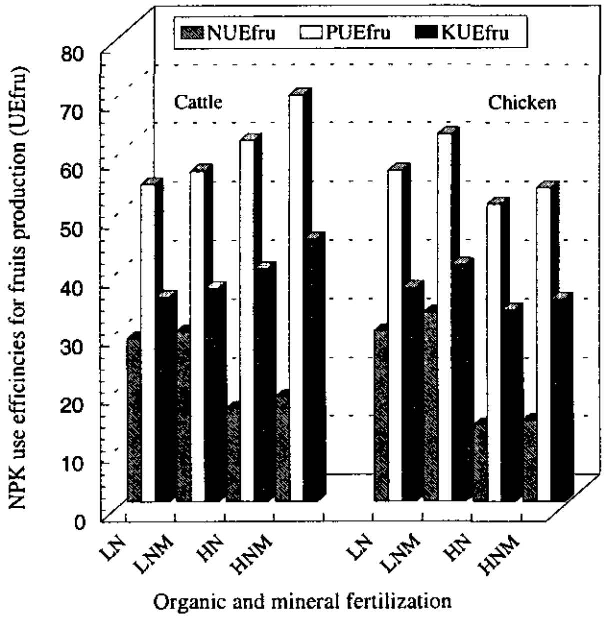

Figure 7. NPK fertilizers use efficiencies for fruits production as affected by mineral fertilization treatments, values being averaged over the two growing seasons.

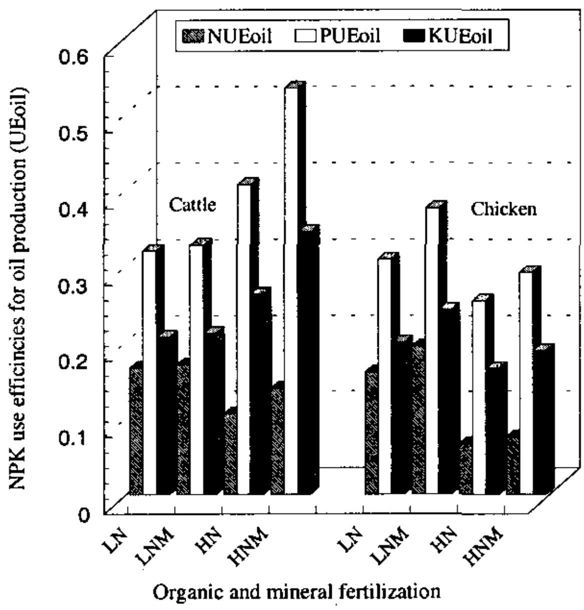

Figure 8. NPK fertilizers use efficiencies for oil production as affected by mineral fertilization treatments, values being averaged over the two growing seasons.

CONCLUSIONS

Agricultural production using sustainable practices under newly reclaimed land conditions can produce high yielding with good quality of crops. Fertilization of Coriander plants with cattle manure + HNM {10m^3/fed + 60 kg N/fed + micronutrients (Fe, Zn and Mn)} or chicken manure + LNM {5m^3/fed + 30 kg N/fed + micronutrients (Fe, Zn and Mn)} under drip irrigation conditions in sandy soils significantly improved growth, yields, percentage of volatile oil and its chemical composition. It also improved macro- (N, P and K) nutrients contents in the plant fruits grown under conditions of fertigated fertilizers in sandy soils in comparison with those plants only organically fertilized. The organic production is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within the system.

REFERENCES

1- Awad, F., K. W. Khalil and M. A. Maksoud. 1993. Comparative effects of some organic manures and bentonite as soil amendments. Agrochimica, 37 (6): 369 - 387. (c.f. soils and fertilizers, 58: 2948).

2- British Pharmacopeia. 1968. Determination of essential oil in drugs. Publ. by the pharmaceutical press. London, W. C. J.

3- Carpenter-Bogges, L., A. C. Kennedy and J. P. Reganold. 2000. Organic and biodynamic management: effect of soil biology. Soil Sci. Soc. Am. J., 64: 1651 -1659.

4- Cooke, G. W. 1975. Timing and placing of fertilizer dressings. In Fertilizing for maximum yield. 2nd edition. Fletcher & son Ltd, Norwich, GB.

5- El-Ghadban, E. A. E. 1998. Effect of some organic and inorganic fertilizers on growth, oil yield and chemical composition of spearmint and marjoram plants. Ph. D. Thesis, Fac. Agric., Cairo Univ.

6- El-Ghawwas, E. O., M. A. Eid and S. M. Mohamed. 2002. Effect of different levels of organic manures and plant distances on fennel (*Foeniculum vulgar*, miller) plant. Egypt. J. of Applied Sciences, 17(3) : 198 - 219.

7- El-Sayed, A. A., M. A. Sidky, H. A. Mansour and M. A. Mohsen. 2003. Response of basil (*Ocimum basilicum* L.) to different Chemical and organic fertilization treatments. J. Agric. Sci, Mansoura Univ., 28 (2): 1401 - 1418.

8- FAO. 1980. Soil and Plant Analysis as Basis of Fertilizer Recommendations. Cottenie, A. (Ed.). Soils bulletin No. 38 (2). Rome.

9- Freed, R. D. 1988. MSTAT-C: A micro computer program for the design, management, and analysis of agronomic research experiments. Michigan State Univ., USA.

10- Gomez, C. A. and A. A. Gomez. 1983. Statistical procedure for Agricultural Research (2nd edition). An international Rice Research Institute book. A Wiley Inter-Science.

11- Gunther, Z. and S. Joseph. 1978. Hand book series in chromatography. CRC, IC.

12- Hartmann, H. T., W. j. Flocker and A. M. Kofranek. 1981. Plant science-Growth, development, and utilization of cultivated plants. Prentice-Hall, Inc., Englewood cliffs, N. j., USA, p.p 178-179.

13- Hegazi, H., A. M. Awad and A. G. Salem. 2002. Influence of foliar K, Mg and micro-nutrients on the yield, quality and essential oil constituents of garlic in sandy soil. J. Agric. Sci., Mansoura Univ., 27 (5): 3417 - 3437.

14- Klute, A. (ed). 1986. Methods of soil Analysis. Part 1. Book series No. 9. American Soc. Agron. and Soil Sci. Soc. America, Madison, Wisconsin, USA.

15- Mortvedt, J. J., F. R. Cox, L. M. Shuman and R. M. Welch. 1991. Micronutrients in agriculture. 2ed edition. Soil Sci. Soc. Am. Book series No. 4. Soil Sci. Soc. Am., Madison, Wisconsin USA.

16- Osman, Y. A. H. 2000. The possibility of production of coriander (*Coriandrum sativum* L.) under Sinai conditions. Ph. D. Thesis, Fac. Agric., Cairo University.

17- Page, A. L. (ed). 1982. Methods of soil analysis, part 2. Book series No, 9. Am. Soc. of Argon. and Soil Sci. Soc. Am., Madison, Wisconsin, USA.

18- Smith, S. J. and A. N. Sharply. 1990. Soil nitrogen mineralization in the presence of surface and incorporated crop residues. Agron. J., 82: 112.

19- Taha, T. T. M. 2002. Effect of mineral and bio-fertilizer on the yield and constituents of some medicinal and aromatic plants grown on sandy soil. Ph. D. Thesis, Fac. Argic., Minufiya University.

20- Tate, R. L. 1989. Soil organic matter biological and ecological effects. A Wiley-Interscience Publication, John Wiley & Sons, New York.

21- Tukey, H. B., S. H. Wittwer and M. J. Bukovac. 1962. The uptake and loss of materials by leaves and other above-ground plant parts with special reference to plant nutrition. Nutrient uptake of plants, Fourth International symposium, Agrochimica Pisa, Florenz, pp. 384 - 413.

22- Westerman, R. L. (ed.). 1990. Soil testing and plant analysis. Third edition. Soil Sci. Soc. Am. Book series No. 3. Soil Sci. Soc. Am., Madison, Wisconsin USA.

23- William, C. T. 1989. Trease and evans, pharmacognosy. 13th edition. Printed in Great Britain by the Alden press, Oxford.

استجابة نبات الكسبرة للتسميد العضوى و المعدنى تحت ظروف الرى و التسميد بالتنقيط في الأراضى الرملية

أمل جابر سالم[1] – أحمد محمد عوض[2]

١ . *قسم بحوث النباتات الطبية و العطرية – معهد بحوث البساتين – محطة بحوث البساتين بالإسكندرية – مركز البحوث الزراعية*

٢ . *قسم بحوث خصوبة الأراضي و تغذية النبات – معهد بحوث الأراضي والمياه والبيئة - محطة البحوث الزراعية بالنوبارية – مركز البحوث الزراعية*

تمت هذه الدراسة تحت ظروف الأراضي الرملية المستصلحة حديثاً المروية بنظام الرى بالتنقيط بالمزرعة البحثية لمركز البحوث الزراعية بقرية علي مبارك – البستان– منطقة النوبارية ، ذلك خلال موسمي شتاء ٢٠٠١/٢٠٠٢ ، ٢٠٠٢/٢٠٠٣. و كان الهدف من البحث هو دراسة استجابة نبات الكسبرة لنوعين من الأسمدة العضوية (مواشي بمعدل ١٠ م٣ / فدان) ، (دواجن بمعدل ٥ م٣ / فدان) أضيفت أثناء خدمة و تجهيز الأرض للزراعة علاوة علي التسميد المعدني الآزوتي بمستويان (منخفض و مرتفع) هما ٣٠ ، ٦٠ كجم آزوت /فدان في صورة سماد نترات الأمونيوم (٣٣,٥% نتروجين) و ذلك في وجود أو عدم وجود رش ورقي بالعناصر الصغرى المخلبية (حديد ، زنك ، منجنيز) (١:١:١) بمعدل ٣٠٠ جم من الخليط / ٣٠٠ لتر ماء/ فدان. و قد اشتملت التجربة على ١٠ معاملات (خمسة معاملات لكل نوع من الأسمدة العضوية) هي ١- سماد عضوي بدون تسميد معدني و تسمى الكنترول ٢- ٣٠ كجم نتروجين /فدان (LN) ٣- ٣٠ كجم نتروجين /فدان + عناصر صغرى(LNM) ٤-٦٠ كجم نتروجين /فدان (HN) ٥- ٦٠ كجم نتروجين /فدان + عناصر صغرى (HNM) .

و قد أوضحت النتائج – بصفة عامة– أنة على الرغم من أن كل المعاملات المختبرة قد أدت إلى تحسين قياسات النمو (طول النبات ، عدد الأفرع) و قياسات الإنتاجية (المحصول و مكوناته) و إنتاجية و جودة الزيت الطيار و تركيز العناصر الممتصة (العناصر الكبرى و الصغرى) لنبات الكسبرة مقارنة بمعاملة الكنترول (تسميد عضوي فقط) إلا أن المعاملة بسماد الماشية + HNM أعطت افضل النتائج بالنسبة لصفات النمو الخضري (طول النبات و عدد الأفرع) و صفات المحصول (عدد النورات الخيمية – وزن البذور للنبات و للفدان و معامل البذرة بالإضافة إلى النسبة المئوية للزيت الطيار و تبعتها المعاملة بسماد الدواجن + LNM. تأثرت كفاءة استخدام عناصر النتروجين و الفسفور و البوتاسيوم لإنتاج البذور و إنتاج الزيت بنوع السماد العضوي المستخدم و معدل السماد النتروجيني المضاف مع مياه الري بالتنقيط.

و أدى التحليل الكروماتوجرافي للزيت باستخدام جهاز (GC-MS) الى التعرف على ١٤ مكون للزيت الطيار اختلفت نسبها المئوية باختلاف المعاملات و كان أهمها زيت اللينالول (المكون الرئيسي للزيت الطيار في الكسبرة) و قد تم الحصول على أعلى نسبة مئوية للينالول باستخدام سماد المواشي + HN و يتبعة سماد الدواجن + LNM ثم سماد المواشي + HNM.

من النتائج يمكن ان نستخلص انة يمكن باستخدام افكار الزراعة المستدامة انتاج محاصيل ذات انتاجية عالية و بجودة لا تقل عن جودة المنتجات المنتجة في الزراعة العضوية مما يذيد من فرص تصدير هذة المنتجات الزراعية ، ناهيك عن الاكتفاء الذاتي و قيمتها الغذائية و الصحية و الاقتصادية العالية للمواطن المصرى.