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EFFICIENCY OF CHEMICAL, BIOLOGICAL FERTILIZERS AND GIBBERELLIN ON *CORIANDRUM SATIVUM L.* UNDER THE CONDITION OF SALINITY AND CALCAREOUS SOIL

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This study was carried out in Maryout experimental research station in two successive seasons: 2000 and 2001 to study the effect of foliar fertilization with a commercial compound biofertilizers. Some growth regulators and bacteria for the purpose of increasing the efficiency of fertilizers were used. Saline water (4000ppm to 5000ppm) was used for irrigation. Plant growth, yield of seeds, essential oil productivity and chemical composition of coriander plants (*Coriandrum stativum* L.) were taken as indicators for the effect of these treatments on increasing the efficiency of fertilizers.

The application of balanced rates of NPK in the form of Ucafalt plus and foliar application of gibberellins and Azotobacter increased the plant height, number of branches, total fresh and dry weight/plant, fruit yield, essential oil percentage, essential oil yield and the plant content of N, P, K, Fe, Zn, and Mn.

Keywords: macro and micro nutrients, gibberellin, *Azotobacter*, saline water.

Coriandrum plant (*Coriandrum stativum L.*) belongs to family umbelliferae. Coriandrum stativum cultivated area in 1998 was 17686 feddans out of 52618 feddans being the total area of medicinal and aromatic plants in Egypt which forms about 34% of the total area. Assiut and Al-Minia governorates cultivate about 90% of the area cultivated by *Coriandrum stativum* (El-Keltawi *et al.*, 1999). The fruits, herbs, and oil are used for medicinal purposes and are used internally in the form of an infusion flavoring foods (Raju and Reddy1990; Chaire and William,1998) as well as antimicrobial, antifungal and antioxidant (Graspicova and Curda,1971; Baratta *et al.*, 1998), antidiabetic (Gray and Flatt, 1999) and antibiotic (Guzhava *et al.*, 1992). Increasing the demand for this crop necessitates enhancing its production either by expanding the plant area which is very difficult or by improving its productivity by technical efforts. Balanced rates of fertilizers may improve the plant growth and increase its productivity within the same available area allocated for this crop. Soil application of fertilizer particularly in saline soil or in soil irrigated by saline water may reduce the efficiency of applied fertilizer and thus limit the plant yield. Foliar application may help in avoiding such problem. Uses of mineral fertilizer is quite common in general while biofertilizer is still in its infancy. The purpose of this work aimed to increase the yield of coriander and improve its quality by selecting the best balanced rates of mineral, fertilizers hormone and growth regulator when sprayed on the plants as foliar application.

MATERIALS AND METHODS

This work was carried out in Maryout experimental station of Desert Research Center for two successive seasons of 2000 and 2001. After land preparation coriander seeds were sown in ridges of width 60cm in hills, 20cm apart early in October of each season. Drainage water of salinity as high as 4000ppm were used for irrigation by furrow method of irrigation. Frequency of irrigation was at ten days intervals throughout the season. Irrigation was stopped two weeks before harvesting. Representative soil samples were collected for analysis prior to planting. Different rates of compound fertilizer commercially called Ucafalt plus which contains 25% N, 17% P, 13% K, 0.3% Mg, 0.2% Fe and 0.1 Mn. Few of other nutrients such as Cu, Zn, B and also vitamins and sugar at two concentrations of 1% and 2%, gibberellins (C_{19} H_{22} D_1) commercially called Berlex were supplied as growth regulator at 100 and 200ppm, Azotobacter at different combinations as shown in the result tables.

The first dose of all fertilizers and growth regulators were sprayed a month after planting followed by the second and the third spray at monthly intervals. Number of treatments were thirteen with three replications. Each experiment was placed under completely randomized block design. Plot area was $6m^2$ (2×3m).

Different measurements were taken to evaluate plant growth in each treatment. Growth parameters included plant height, number of branches, plant fresh weight and plant dry weight. Yield parameters included fruit diameter, dry fruit yield and essential oil yield according to British Pharmacopoeia (1963). Plant contents of nutrients (N, P, K, Na, Fe, Mn, Zn) were determined according to Chapman and Pratt (1961). Essential oil was subjected to fractional treatment using separation conditions of essential oil.Instrument: GAS Liquid Chromatography/Pye Unicam Pro-GC.Column: Ov-17 (Methyl phenyl silicone) Dimensios 1.5×4mm.

TABLE (1). Physical and chemical properties of soils.

a- Physical properties				
Depth (cm)	Sand%	Silt%	Clay%	Texture
0-30	32.2	30.1	37.7	Clay Loam

b- Chemical properties										
EC dS/m	pH	$CaCO_3$ %	OM %	Soluble cations and anions (meq/L)						
				Na^+	Ca^{++}	Mg^{++}	K^+	Cl^-	HCO_3^-	$SO_4^=$
5.9	8.1	32	0.30	25	23	9	2	30	9	20

Temperature programming

Initial Temp	70 °C
Rate	8 °C /min
Final Temp	200 °C
Final Time	25 min
Injector	250 °C
Detector	300 °C
Gases Flow Rate	
N_2	30 ml/min
H_2	33 ml/min
Air	33 ml/min
Chart Speed	0.4 cm/min

The reference materials were injected under the same conditions. All collected data were subjected to statistical analysis according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Data obtained from these experiments could be classified according to the effect of each treatment on plant growth, yield parameters and plant contents of different elements and essential oil. Below is an attempt to highlight these points.

Plant Growth

Plant height, number of branches, plant fresh weight and plant dry weight form the most important parameters and indicators for the plant condition and growth.

Plant height

Plant height in the two seasons ranged from 71 to 110.8 cm in average. It seemed that plant height was positively affected by all treatments. As shown in table (2), the highest plant growth as reflected by plant height was obtained in response to the foliar application of NPK in combination with gibberellin (GA_2). This was followed by both treatments ($Foliar_2$+GA_1 and GA_2+Azot) and then by GA_2 , $Foliar_1$+GA_1, $Foliar_1$+GA_2 in descending order. The response, observed here, to the foliar application of NPK mixed with gibberrellin may be due to the sufficient amounts of N in both sources. This may be supported by the fact that nitrogen plays a role in protoplasm metabolism and thus plant height and growth. On the role of nitrogen on plant growth, Tisdale *et al.* (1985) summarized a number of reports and explained that nitrogen plays an important role in the formation of protein and forms an integral part of chlorophyll which is the primary absorber of light energy needed for photosynthesis. Many authors including Garg *et al.* (2000), Subramanion and Vijaykumer (2001) and Oliveira *et al.* (2003) investigated the effect of N fertilizer on the growth of coriander plants. Balanced rate of fertilizer provided by the contents of both sources may not be ignored as a good condition for increasing plant height and plant growth subsequently. Das *et al.* (1991) working on sandy loam soil in India found that N at a rate of 40 kg/ha increased coriander growth parameters. Also Ughreja and Chundawat (1992b) recorded a positive effect of N on the growth of coriander planted and this effect was enhanced with the additional of both P and K.

TABLE (2). Plant height as affected by foliar, Gibberellin and Azotobacter on *Coriandrum stativum L* in 2000 and 2001 seasons.

Treatments	Plant height (cm)			Treatments	Plant height (cm)		
	2000	2001	Mean		2000	2001	Mean
Control	69.7	72.3	71.0	$Foliar_2$+Azoto	94.3	88.3	91.3
$Foliar_1$	78.7	82.3	80.5	GA_1+Azoto	101.0	97.0	99.0
$Foliar_2$	87.7	90.0	88.9	GA_2+Azoto	108.3	103.3	105.8
GA_1	93.7	97.3	95.5	$Foliar_1$+ GA_1	101.3	98.0	100.0
GA_2	99.3	102.3	100.8	$Foliar_2$+ GA_1	108.3	102.3	105.3
Azotobacter	94.0	98.0	96.0	$Foliar_1$+ GA_2	103.0	100.0	101.5
$Foliar_1$+Azoto	89.3	83.3	86.3	$Foliar_2$+ GA_2	112.3	109.3	110.8
LSD 5%	6.0	6.0	---	LSD 5%	6.0	6.0	---

$Foliar_1$ =Ucafalt-plus 1% $Foliar_2$ =Ucafalt-plus 2%
GA_1= Gibberellin 100ppm GA_2= Gibberellin 200ppm

Number of branches

As shown in table (3) the number of branches was affected by all treatments with various rates. Such increase coincided with the increase of plant height which seemed to be logic. The taller the plant the larger number of branches it carries. Number of branches ranged from as high as 119 branches per plant at the application of $foliar_2$+GA_1 to the lowest number of 44 branches/plant in the control. The big difference may indicate the incapability of the soil to maintain normal growth without application of fertilizer. Das *et al.* (1991) reported similar results.

TABLE (3). Effect of foliar , Gibberellin, Azotobacter and their combinations on number of branches of plants in 2000 and 2001 seasons.

Treatments	Number of branches/plant			Treatments	Number of branches/plant		
	2000	2001	Mean		2000	2001	Mean
Control	40	49	44	$Foliar_2$+Azoto	89	82	85
$Foliar_1$	64	73	68	GA_1+Azoto	92	89	90
$Foliar_2$	80	83	81	GA_2+Azoto	112	105	108
GA_1	86	88	87	$Foliar_1$+ GA_1	102	95	98
GA_2	101	106	103	$Foliar_2$+ GA_1	124	115	119
Azotobacter	87	95	91	$Foliar_1$+ GA_2	114	109	111
$Foliar_1$+Azoto	75	79	77	$Foliar_2$+ GA_2	126	121	123
LSD 5%	12	9.9	---	LSD 5%	12	9.9	---

$Foliar_1$ =Ucafalt-plus 1% $Foliar_2$ =Ucafalt-plus 2%
GA_1- Gibberellin 100ppm GA_2- Gibberellin 200ppm

Plant dry weight

Data in table (4) show that plant dry weight was affected by all treatments. However the effects varied with the type and rate of fertilizer used. The highest response was recorded for $foliar_2$ with combination of Azotobacter or any of GA_2 and GA_1. Other treatment increased the dry matter content significantly when compared with the control. This result is not surprising since plant dry weight is a reflection to plant growth . Thus, plant dry weight followed the same trend observed in plant height and number of branches as discussed earlier (Pralu *et al.*, 2002).

TABLE (4). Plant dry weight as affected by foliar, Gibberellin, *Azotobacter* and their combinations in 2000 and 2001 seasons.

Treatments	Dry weight (g/plant)			Treatments	Dry weight (g/plant)		
	2000	2001	Mean		2000	2001	Mean
Control	11.2	12.8	12.0	$Foliar_2$+Azoto	27.3	26.6	27.0
$Foliar_1$	18.2	19.4	19.1	GA_1+Azoto	27.7	27.0	27.4
$Foliar_2$	21.0	22.4	21.7	GA_2+Azoto	29.6	28.8	29.2
GA_1	23.0	23.5	23.3	$Foliar_1$+ GA_1	21.8	22.4	22.1
GA_2	23.9	24.8	24.4	$Foliar_2$+ GA_1	25.3	24.3	24.8
Azotobacter	25.2	25.9	25.6	$Foliar_1$+ GA_2	25.4	24.8	25.1
$Foliar_1$+Azoto	24.2	22.9	23.6	$Foliar_2$+ GA_2	26.5	25.6	26.1
LSD 5%	0.6			LSD 5%	0.7		

$Foliar_1$ =Ucafalt-plus 1% $Foliar_2$ =Ucafalt-plus 2%
GA_1 Gibberellin 100ppm GA_2 Gibberellin 200ppm

From the above discussion it could be summarized that plant height, number of branches and plant dry weight are considered the direct parameters that reflect the condition of plant growth. Similar results were reported by Osman and El-Mogy (2005) on the same crop. The link between them and their response to different treatments were clear. Plant growth responded to all treatments and this could be directly related to the poor fertility status of the soil as shown in the analysis of soil mentioned earlier. The degree of response differed from treatment to another but it was high in combination of different sources. This was clear in combination of foliar (NPK), with any of other treatment such as Azotobacter or gibberellins Das *et al.* (1991). These combinations seemed to have granteed satisfaction to plants that grow well under these conditions. Besides combination of different sources of fertilizer provide a balanced fertilizer that help plant growth in general. It is not advisable to name one of these treatments as the best since most of them gave significant response for plant growth. The choice, therefore, between any of them may be based in their availability, cost involved and the comfort of the user.

Fruit diameter

Fruit diameter as shown in table (5) ranged from 6.8 to 9.3cm in general except that of control that was very small (4.0cm). The narrow range between the highest and the lowest value of fruit diameter may not serve the purpose of comparison. However, it could be taken as a reflection to plant growth. Strong plants normally carry big fruits but this is not always true since fruit diameter depends on so many other factors. Some of these factors are the number of fruits carried by each plant, the location of the fruits on the plant and time of fruiting. In any way, the fruit diameter values in the table should not be taken for grants unless linked with other parameters that support the hypothesis of strong growth give strong fruit. In this experiment it seems difficult to point out this link due to the narrow range of the values recorded and their inconsistency.

TABLE (5). Fruit diameter as affected by foliar, Gibberellin, Azotobacter and their combinations in 2000 and 2001 seasons.

Treatments	Fruit diameter (cm)			Treatments	Fruit diameter (cm)		
	2000	2001	Mean		2000	2001	Mean
Control	3.8	4.2	4.0	$Foliar_2$+Azoto	8.5	7.9	8.2
$Foliar_1$	6.5	7.2	6.8	GA_1+Azoto	8.6	7.5	8.0
$Foliar_2$	8.2	8.8	8.5	GA_2+Azoto	9.4	8.8	9.1
GA_1	7.3	8.1	7.7	$Foliar_1$+ GA_1	7.8	7.1	7.4
GA_2	8.2	9.5	8.3	$Foliar_2$+ GA_1	8.9	8.6	8.7
Azotobacter	8.3	8.7	8.5	$Foliar_1$+ GA_2	9.2	8.9	9.0
$Foliar_1$+Azoto	7.9	7.4	7.6	$Foliar_2$+ GA_2	9.6	9.1	9.3
LSD 5%	0.6	0.5	---	LSD 5%	0.6	0.5	---

$Foliar_1$ = Ucafalt-plus 1% $Foliar_2$ = Ucafalt-plus 2%
GA_1 Gibberellin 100ppm GA_2 Gibberellin 200ppm

Fruit yield

Fruit yield as shown in table (6) ranged from 214kg/fed^{-1} at the control to as high as 598kg/fed^{-1} in the treatment $foliar_2$, $foliar_2$+GA_1 and $foliar_2$+Azotobacter. The fruit yield did not correspond well with the figures of fruit diameter for the reasons given above. It seems that fruit yield corresponded well with most treatments that encourage plant growth in such a poor soil that lacks most of this nutrients applied. Therefore, any addition of fertilizer was able to provide better condition for plant growth and thus improvement of fruit yield. The treatment that supply larger number of elements in a balanced rate performed better. This was clear in using gebberellines as a regulating fertilizer and also the foliar application of a combined rate of NPK. Other treatments contributed in increasing the fruit yield with varying degrees. These results were in agreement with those obtained by Channalbasavanna (2002) and Surendra *et al.* (2002) on *Coriandrum sativum*.

TABLE (6). Effect of foliar, Gibberellin, Azotobacter and their combinations on yield of branches of fruits in 2000 and 2001 seasons.

Treatments	Dry Fruit (kg/fed)			Treatments	Dry Fruit (kg/fed)		
	2000	2001	Mean		2000	2001	Mean
Control	187	241	214	$Foliar_2$+Azoto	584	535	559
$Foliar_1$	385	453	419	GA_1+Azoto	511	486	498
$Foliar_2$	568	615	591	GA_2+Azoto	576	549	563
GA_1	402	449	425	$Foliar_1$+ GA_1	434	380	407
GA_2	460	512	486	$Foliar_2$+ GA_1	528	497	513
Azotobacter	495	528	511	$Foliar_1$+ GA_2	590	577	584
$Foliar_1$+Azoto	481	437	495	$Foliar_2$+ GA_2	613	583	598
LSD 5%	43	37	---	LSD 5%	33.9	37.2	---

$Foliar_1$ =Ucafalt-plus 1% $Foliar_2$ =Ucafalt-plus 2%
GA_1- Gibberellin 100ppm GA_2- Gibberellin 200ppm

Essential oil

The same trend was observed in the essential oil yield as shown in table (7). Essential oil yield is a multiple of fruit yield and the percentage of oil in the seeds shown in table (8). Oil percentage ranged in this experiment from 0.17% to 0.42% which seemed to be far below that in the literature. For example, Guenther (1972) reported a percentage of to 6-7% in general, Strasil (1997) reported a range of 7.6 to 23.3%, Osman and El-Mogy (2005) showed a range of 1.2 to 3.4% and Bosaelah (1995) showed an average of 0.34%. This diversity may reveal that oil percentage on this crop depends on other factors rather than the soil condition or type of fertilizer used. Plant varieties, genetic, characteristics and climatic condition are few to count in this regard.

Essential oil constituents

Results of the GLC as shown in table (9) and figure (1) revealed that it was possible to recognize thirteen component in the oil of cariandrum staivum. The oil contained a higher percentage of a component called Compher (56.90%), followed by Borneal (27.59%) and then by Carvone (6%). Other components namely Linalool, Anethal, Terpenial and Eugenal formed about 2.5% of the oil. Other unnamed identified components formed about 3% of the oil as shown in table (9). Different components of oil were reported by Bosaelah (1995) for the same crop irrigated with saline water. These differences were attributed to the effect of salinity.

TABLE (7). Essential oil yield as affected by foliar , Gibberellin, Azotobacter and their combinations in 2000 and 2001 seasons.

Treatments	Essential oil yield (kg/fed)			Treatments	Essential oil yield (kg/fed)		
	2000	2001	Mean		2000	2001	Mean
Control	0.31	0.48	0.40	$Foliar_2$+Azoto	2.41	2.04	2.23
$Foliar_1$	1.18	1.51	1.35	GA_1+Azoto	1.63	1.46	1.55
$Foliar_2$	2.23	2.60	2.42	GA_2+Azoto	2.29	2.06	2.18
GA_1	1.16	1.50	1.33	$Foliar_1$+ GA_1	1.46	1.20	1.33
GA_2	1.48	1.88	1.68	$Foliar_2$+ GA_1	1.82	1.60	1.71
Azotobacter	2.04	2.18	2.11	$Foliar_1$+ GA_2	2.14	1.96	2.05
$Foliar_1$+Azoto	1.65	1.32	1.49	$Foliar_2$+ GA_2	2.34	2.19	2.27
LSD 5%	0.23	0.35	---	LSD 5%	0.23	0.35	---

$Foliar_1$ =Ucafalt-plus 1% $Foliar_2$ =Ucafalt-plus 2%
GA_1= Gibberellin 100ppm GA_2= Gibberellin 200ppm

TABLE (8). Effect of foliar, Gibberellin, Azotobacter and their combinations on essential oil in 2000 and 2001 seasons.

Treatments	Essential oil (%)			Treatments	Essential oil (%)		
	2000	2001	Mean		2000	2001	Mean
Control	0.17	0.20	0.19	$Foliar_2$+Azoto	0.41	0.39	0.40
$Foliar_1$	0.31	0.35	0.33	GA_1+Azoto	0.32	0.30	0.31
$Foliar_2$	0.39	0.42	0.41	GA_2+Azoto	0.40	0.38	0.39
GA_1	0.27	0.33	0.30	$Foliar_1$+ GA_1	0.34	0.30	0.32
GA_2	0.34	0.34	0.36	$Foliar_2$+ GA_1	0.35	0.32	0.34
Azotobacter	0.40	0.42	0.41	$Foliar_1$+ GA_2	0.36	0.35	0.36
$Foliar_1$+Azoto	0.34	0.30	0.32	$Foliar_2$+ GA_2	0.38	0.39	0.39
LSD 5%	0.03	0.05	---	LSD 5%	0.03	0.05	---

$Foliar_1$ =Ucafalt-plus 1% $Foliar_2$ =Ucafalt-plus 2%
GA_1= Gibberellin 100ppm GA_2= Gibberellin 200ppm

Carbohydrate and soluble sugar

As shown in table (10) total carbohydrate contents varied from 8.7% to 14.2% of the total dry weight. Changes in the carbohydrate seemed to be positively affected by all treatments. $Foliar_2$+GA_2 was more effective in increasing the total carbohydrates followed by $Foliar_2$+Azotobacter and then by all treatments that contained gebbrelline. The total carbohydrate content coincided with the vegetative growth explained earlier. This must be so since amount of carbohydrate formed by a plant is a reflection to the condition of the plant and the plant growth in general. Soluble sugar content as shown in table (10) ranged from 1.6% to 3.7%. Soluble sugar is a stage in the formation of total carbohydrates therefore, formation of total carbohydrate depends mainly on the presence of soluble sugar. The more the content of soluble sugar the more the formation of total carbohydrate. It is not surprising to watch that the soluble sugar content coincided well with the total carbohydrate. Therefore, all the treatments affected the soluble sugar content affected in the same time the content of carbohydrate which was effective on plant growth as discussed before. Balanced of fertilizer that provide essential plant nutrients in enough quantities and in a balanced rates play an essential role in increasing plant growth, soluble sugar content and total carbohydrates.

TABLE (9). Results of the GLC investigation on the *Coriandrum staivum* oil.

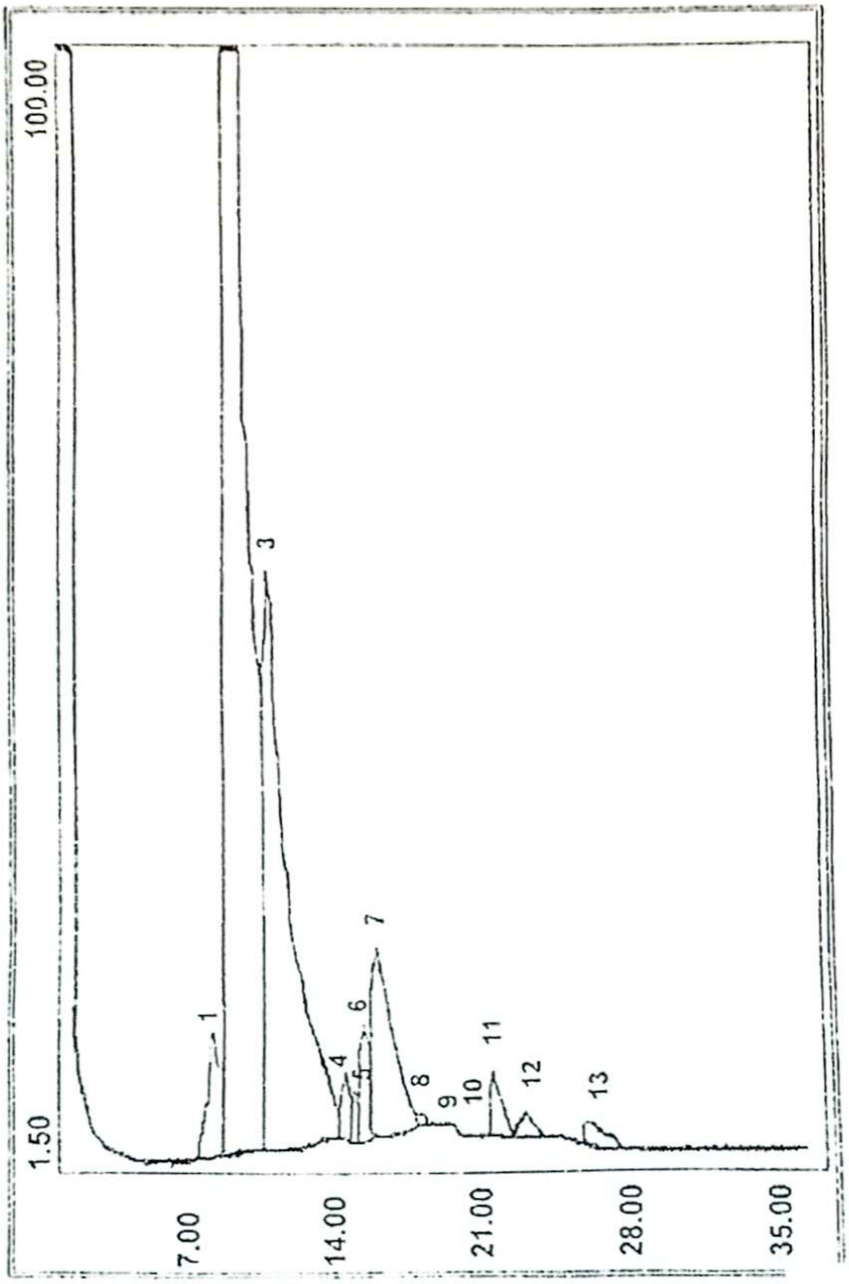
Peak	Name	RT (Mins)	Area	Height	Base	Conc. %
1	Linalool	7.933	422.125	11.283	2.972	2.972
2	Compher	9.133	8091.500	97.324	2.676	56.966
3	Borneal	10.550	3933.216	50.514	3.106	27.591
4	Anethal	14.083	136.255	4.312	1.179	0.959
5	Terpenial	14.583	68.861	4.014	4.331	0.485
6	Eugenal	15.017	276.267	9.211	1.463	1.945
7	Carvone	15.583	872.442	15.950	4.635	6.142
8	——	17.667	23.229	0.998	5.268	0.164
9	——	18.933	9.181	0.295	4.922	0.065
10	——	20.450	4.174	0.301	4.496	0.029
11	——	21.067	169.855	5.614	4.552	1.196
12	——	22.617	105.417	2.241	4.218	0.742
13	——	25.883	91.639	1.416	3.605	0.645

RT= Retention time

TABLE (10). Effect of foliar, Gibberellin, *Azotobacter* and their combinations on total carbohydrates and soluble sugars in 2000 and 2001 seasons.

Treatments	Total carbohydrates %			Soluble sugars %		
	2000	2001	Mean	2000	2001	Mean
Control	8.20	9.10	8.65	1.50	1.70	1.60
$Foliar_1$	10.10	11.30	10.70	2.10	2.30	2.20
$Foliar_2$	13.00	13.50	13.25	3.00	3.20	3.10
GA_1	11.60	12.00	11.80	2.50	2.80	2.65
GA_2	12.70	12.90	12.80	2.60	2.90	2.75
Azotobacter	12.50	13.00	12.75	2.80	3.00	2.90
$Foliar_1$+Azoto	12.90	13.40	13.15	2.30	2.60	2.45
$Foliar_2$+Azoto	13.40	13.90	13.65	3.10	3.40	3.25
GA_1+Azoto	12.60	12.90	12.75	2.70	2.80	2.75
GA_2+Azoto	13.30	13.60	13.45	2.90	3.10	3.00
$Foliar_1$+ GA_1	12.10	12.80	12.45	2.40	2.70	2.55
$Foliar_2$+ GA_1	12.80	13.10	12.95	2.90	3.00	2.95
$Foliar_1$+ GA_2	13.20	13.60	13.40	3.20	3.50	3.35
$Foliar_2$+ GA_2	13.70	14.60	14.15	3.60	3.80	3.70
LSD 5%	0.78	0.85	0.82	0.16	0.18	0.17

$Foliar_1$ =Ucafalt-plus 1% $Foliar_2$ =Ucafalt-plus 2%
GA_1 Gibberellin 100ppm GA_2 Gibberellin 200ppm



Minutes

Fig (1). GLC analysis of *Coriandrum sativum L.* oil

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Plant uptake of nutrients

Plant uptake of macronutrients and micronutrients as shown in table (11) were estimated by multiplying the plant weight by the concentration of any given element. The highest plant uptake of N reached 37 kg / feddan. Plant uptake of N corresponded well with the application of different sources of N. Similarly, the application of any given element was reflected on the uptake of such element and plant growth. Phosphorus uptake ranged from 1.5 to 8.0 kg / feddan. Potassium uptake ranged from 12 to 60 kg/feddan. Micronutrients uptake reached up to 3 kg/feddan for Zn and 0.4 kg/feddan for Mn. Plant uptake of all these nutrients could be considered as a good guide for estimating the fertilizer requirement for any of them and for this particular crop. The soil content of such elements must be taken into consideration when estimating the fertilizer requirement of any given element. These results agreed with those obtained by Ughreja and Chundawat (1992 a) and Sivakumaran *et al.* (1996) on *Coriandrum staivum*.

TABLE (11). Nutrients uptake of aerial parts of plants as affected by foliar, Gibberellin, *Azotobacter* and their combinations.

Treatments	Uptake in kg/fed						
	Average aerially dry weight (kg/fed[1])	N	P	K	Fe	Zn	Mn
Control	645.70	5.78	1.52	11.95	0.75	0.06	0.05
$Foliar_1$	1231.00	17.17	5.79	38.46	1.85	0.17	0.23
$Foliar_2$	1482.10	26.53	7.56	51.87	2.40	0.22	0.30
GA_1	1158.60	13.35	3.88	24.97	1.32	0.13	0.12
GA_2	1264.20	15.17	4.42	27.81	1.58	0.15	0.16
Azotobacter	1227.30	17.06	5.40	37.43	1.98	0.18	0.24
$Foliar_1$+Azoto	1404.10	29.14	6.60	48.09	2.40	0.22	0.30
$Foliar_2$+Azoto	1579.65	36.65	7.96	60.03	3.23	0.28	0.37
GA_1+Azoto	1285.05	18.58	4.24	32.70	2.30	0.16	0.20
GA_2+Azoto	1397.20	21.17	4.96	39.12	2.64	0.18	0.24
$Foliar_1$+ GA_1	1290.90	17.56	4.91	48.41	1.94	0.17	0.21
$Foliar_2$+ GA_1	1445.56	19.80	6.22	49.87	2.18	0.19	0.25
$Foliar_1$+ GA_2	1544.50	24.09	7.10	49.81	2.39	0.21	0.27
$Foliar_2$+ GA_2	1635.35	28.70	7.52	55.68	2.62	0.23	0.31

$Foliar_1$ =Ucafalt-plus 1% $Foliar_2$ =Ucafalt-plus 2%
GA_1= Gibberellin 100ppm GA_2= Gibberellin 200ppm

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كفاءة التسميد الكيماوى والحيوى مع الجبريللين على محصول الكزبرة تحت ظروف الرى بالمياه المالحة فى الأراضى الجيرية

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أجريت هذه الدراسة لمدة عامين متتاليين (١٩٩٩/٢٠٠٠-٢٠٠٠/٢٠٠١) فى محطة بحوث مريوط بزراعة نبات الكزبرة وإتباع الأصول الفنية فى رعايته والاهتمام به من حيث مواعيد الزراعة والرى ومقاومة الحشائش والآفات. وقد استخدمت مياه رى ذات ملوحة مرتفعة نسبياً وهى المياه المتوافرة فى المحطة وتتراوح نسبة الملوحة بها ٤٠٠٠ إلى ٥٠٠٠ جزء/مليون.

واستخدم فى تسميد هذا المحصول مصادر مختلفة من الأسمدة بطريقة الرش على النباتات واشتملت هذه الأسمدة على مركب سمادى متوازن يعرف تجارياً باسم يوكافول – بلس واستخدم بتركيزين ١% و٢% ويحتوى على النتروجين والفوسفور والبوتاسيوم بصفة أساسية وعناصر الحديد والزنك والمنجنيز كما اشتملت المعاملات أيضاً على مركب الجبريللين واستخدم بتركيزين ١٠٠ ، ٢٠٠ جزء/مليون بالإضافة للتسميد الميكروبيولوجى بمحلول يحتوى على الأزوتوباكتر. وتم إضافة هذه المصادر السمادية منفرده وأيضا مختلطة بجميع التوافيق الممكنة بينها. ونتج عن ذلك عدد ١٤ معاملة بالإضافة إلى معاملة المقارنة.

وقد أفادت النتائج المتحصل عليها إلى أهمية إضافة هذه الأسمدة وبصورها المختلفة فى تحسين النمو بصفة عامة وزيادة إنتاج النباتات من الثمار والزيت والمحتوى النباتى من هذه العناصر المضافة وأن إضافة المصادر السمادية المتزنة كان لها تأثيراً كبيراً على زيادة المحصول وزيادة إنتاجيته.

أما بخصوص نسبة الزيت فى النباتات فى هذه التجربة فقد تراوحت بين ٠,١٧% و٠,٤٢%. وأظهرت نتائج التحليل الكروموتوجرافي على احتواء الزيت على ٥٦,٩٦% كمفور، ٢٧,٥٩% بورنال، ٦,١٤% كارفون، ٢,٩٧% ليتالوول، ١,٩٤% ايوجنال، ٠,٩٥% انثول، ٠,٤٨% تربينال .

وقد أوضحت النتائج أيضاً أهمية التسميد الميكروبيولوجى والتسميد بالمركبات المتوازنة فى زيادة كفاءة الأسمدة المستخدمة لزيادة انتاجية محصول الكزبرة.