EFFECT OF COMPOST AND NUMBER OF CUTTINGS ON PRODUCTIVITY OF CORIANDRUM SATIVUM L. UNDER SINAI CONDITIONS

Abd El-Azim, Waleed M.

Department of Medicinal and Aromatic Plants, Desert Research Center, El-Matareya, Cairo, Egypt E-mail: dr.w_elzeary@yahoo.com

> wo field experiments were carried out at El-Maghara Research Station (Middle Sinai) of the Desert Research Center (DRC), during 2014/2015 and 2015/2016 seasons, to study the effect of two doses of organic compost; 10 and 20 m³/feddan and three cuttings frequencies (without cutting, one cutting at 45 days after sowing and two successive cutting at 45 and 60 days after sowing) on the growth and essential oil content of Coriandrum sativum L. plant grown in sandy soil. The obtained results revealed that, the best growth parameters (plant height, number of branches, weight of 1000 seeds (g), weight of seeds per plant (g), yield of seeds (kg/feddan), oil percentage, oil yield (L/feddan), total nitrogen and carbohydrate percentages and essential oil composition were obtained by using a combination of 20 m³/feddan compost and one cutting, after 45 days after sowing, except for plant height that showed the beast results associated with "without cutting" treatment.

Keywords: Coriandrum sativum, compost manures, cutting, essential oil, GC-mass

Coriander (*Coriandrum sativum* L.), a member of the family Apiaceae, is one of the important spice crops grown throughout the world. This plant has been used as a flavoring agent in food products, perfumes and cosmetics. As a medicinal plant, seeds of *Coriandrum sativum* have been recommended for dyspeptic complaints, convulsion, insomnia and anxiety (Emamghoreishi et al., 2005). While, the green leaves is a rich source of vitamin A. It is used in salad and gives a flavoring of soups as well as fish dishes (Singh, 1976).

The organic sources of fertilizer are helpful in increasing the availability and uptake of nutrients from the soil by plant. Compost, which is applied as organic source of fertilizer has been safe for human health and the environment. Compost can be used to improve soil structure, making soil easier to be cultivated and encouraging the root system to develop (Allison, 1973). Several investigators revealed that, application of compost to the soil caused promoton to different growth characters and chemical constituents of *Coriandrum sativum*; namely Hussein et al. (2010), Moslemi et al. (2012) and Rajesh et al. (2015). Leaf cutting has been reported to increase the number of branches and umbels per plant, which in turn increase the yield of leaves and seeds in *Coriandrum sativum* (Tiwari et al., 2002 and Moniruzzaman and Rahman, 2015). In this study the effect of compost in two doses and number of cutting on the productivity of *Coriandrum sativum* has been highlighted.

MATERIALS AND METHODS

Two field experiments were carried out at El-Maghara Experimental Station of the Desert Research Center (DRC), during 2014/2015 and 2015/2016 seasons, to study the effect of two doses of organic compost (10 and 20 m^3 /feddan) and three cutting frequencies (without cutting, one cutting at 45 days after sowing and two successive cuttings at 45 and 60 days after sowing) on the growth and essential oil content of Coriander plant grown in sandy soil. Physical and chemical analyses of experimental soil and irrigation water were presented in table (1). The chemical analysis of compost is presented in table (2).

Seeds were sown on soil in 15 and 18 October for the first and second seasons, respectively. In both seasons, seeds of Coriander plant were obtained from the Experimental farm of El-Maghara Station. The experimental design was split plot in three replicates with six treatments, which were the combination of two doses of compost and three cutting. The main plots were randomly devoted to organic compost treatments, while the sub-plots were assigned to number of cuttings. Plot area was 6 m². In land preparation, compost in addition to calcium superphosphate at a rate of 32 P₂O₄ were mixed with the soil before sowing. Nitrogen and potassium fertilizers were added at the rate of 80: 24, N: K₂O kg/feddan divided in two equal doses a recommended rate reported by Osman (2000). The first addition was after one month from sowing, while the second was applied after one month after the first. Seeds were sown 30 cm between hills on rows; 75 cm apart, thinning for two plants in hill. Experimental plots were irrigated using drip irrigation 4 L/h, day after day in two additions in the morning and afternoon. The plants were harvested in the end of season in 17 and 21 April in the two seasons. Meanwhile, plant height, number of branches, weight of 1000 seeds, weight of seeds per plant (g), yield of seeds (kg/feddan), oil percentage, oil yield (L/feddan), total nitrogen percentage and total carbohydrate percentage were recorded for each season of Coriander plant. Chemical analysis included, total carbohydrate according to Chaplin and Kennedy (1994) total nitrogen according to James (1995). The essential oil composition in some different treatments was determined using

[Physical	properti	es					Chemics	al prope	rties of	soil			
Coarse	Fine	Silt	Soil	рH	E.C.	OM		Soluble	cations			Soluble	anion :	
sand	sand	and	texture		<u>(</u>	%		(me	q/L)			(me	q/L)	
%	0%	clay			mho		\mathbf{K}^{*}	Na^+	Mg^{++}	Ca^{++}	CO3	HCO ₃	Ċ	SO_4
		%			s/cm)						,	,		
				8.60	0.82	0.35	0.09	2.43	0.80	3.20		3.00	1.38	2.14
22.47	74.1	3.43	Sandy					Irrigati	on wate	er analy	sis			
				8.36	4.06	0.40	0.69	24.60	3.48	11.4		4.4	32.20	3.57
		Ι	Table (2). An	alysis o	f compo	st manu	rre used.							
	I			6M0			0%0		P_{00}		Ŕ	%		
		Comp	ost	23.07		1	.17		0.75		1.	87		
	-	OM= orga	mic matter											

Table (1). Mechanical and chemical properties of the experimental soil and irrigatio

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Table (3). Effect	t of comp	oost and n	umber of cutting	treatments on h	eaves fol	iage per p	plant (g) and per	feddan (kg) of 6	Coriandru	'n sativumL.
				Leave	es foliage					
Treatment		First	season, first cu	t		First	season, second	cut		
Compost cut	10 m ³	20 m ³	10 m^3	20 m ³	10 m ³	$20 \ { m m}^3$	10 m^3	20 m^3	10 m ³	20 m ³
									Total	Total
	Plant	yield	yield							
	(g)	(g)	(kg/feddan)	(kg/feddan)	(g	(g)	(kg/feddan)	(kg/feddan)	year	year
									(kg)	(kg)
Without										
Cut 1	4.0	6.5	142.2	231.1				,	142.2	231.1
Cut 2	4.5	5.5	159.9	195.5	24.5	28.2	871.0	1004.6	1030.9	1200.1
				Leave	es foliage					
Treatment		Secol	nd season, first	cut		Secon	d season, second	1 cut		
Compost	10 m ³	20 m ³	10 m ³	20 m ³	10 ш ³	20 m ³	10 m ³	20 m ³	10 m ³	20 ш ³
									Total	Total
	Plant	yield	yield							
	(g)	(g)	(kg/feddan)	(kg/feddan)	(g)	(g)	(kg/feddan)	(kg/feddan)	уеаг	year
									(kg)	(kg)
Without							,			
Cut 1	5.0	6.5	177.7	231.1				,	177.7	231.1
Cut 2	4.7	7.5	167.1	266.6	28.5	32.5	1013.3	1155.5	1180.4	1422.1

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GC-mass analysis, a TRACE GC Ultra Gas Chromatographs (THERMO Scientific Corp., USA), coupled with a THERMO mass spectrometer detector (ISQ Single Quadrupole Mass Spectrometer).

Yield of foliage leaves cut per plant and per feddan is presented in table (3). The data on the vegetative growth characteristics and chemical compounds were subjected to statistical analysis of variance, and means were compared using the L.S.D. at 5%, as described by Steel and Torrie (1980).

RESULTS AND DISCUSSION

1. Growth Parameters

1.1. Effect of compost manure

The results recorded in the two seasons (Tables 1-3) showed that, the application of compost manure fertilizer with 20 m³/feddan had a significant effect on the different growth characteristics; plant height, number of branches, weight of 1000 seeds (g), weight of seeds/plant (g) and yield of seeds (kg/feddan) compared to add 10 m³/feddan. Similar promotion of growth as result of compost manure was reported by Hendawy and Khalid (2011) on Chamomile, Rajesh et al. (2015) on Coriandrum sativum and Khalid et al. (2015) on Foeniculum vulgare. The favorable effect of the compost manure treatments on growth parameter could be explained by its important role in improving soil productivity fertility and thus yield and quality of crops. Compost may increase the availability and concentration of N and Ca in soil and as a result increase plant uptake of these elements. Moreover, compost cause decreasing in pH in plant rhizosphere, which might increase the availability of macro and micro nutrient. Also, compost increases water-holding capacity of the soil (Al-Rashady, 1987; Hasan, 1995 and Sradnick et al., 2013).

1.2. Effect of cutting

The data presented in tables (1-3) showed that in both seasons, leaves cutting (one or two cuttings) reduced the plant height significantly as compared to no cutting. *Coriandrum sativum* plants without cutting gave the highest mean values for plant height (90.67 and 83.00 cm) in both seasons, followed by one cutting (61.84 and 73.00 cm), while the least values were obtained by cutting the plants twice. On the other hand, one cutting recorded the highest number of branches (45.67 and 47.00), weight of 1000 seeds (15.55 and 14.59 g), seeds/plant (9.92 and 9.81 g) and yield of seed (352.5 and 348.8 kg/feddan). These results suggested that, one cutting improves all the growth parameters, except plant height. Similar results were obtained by Thakral et al. (1992), Tehlan and Thakral (2008) and Moniruzzaman and Rahman (2015) on the same plant.

1.3. Effect of interaction between compost and cutting

Regarding the interaction between the effects of compost manure and number of cuttings, data recorded on growth parameters of *Coriandrum* sativum plants (Tables 4-6) showed that, the highest values with different growth parameters were obtained from plants received 20 m³ compost manure and cutting one in both seasons.

 Table (4). Effect of compost and number of cuttings on plant height and number of branches of *Coriandrum sativum* L.

		Plant he	ight (cm)					Nur	nber of b	ranches/	plant	
Treatment	Fir	st seasor	ı	Se	cond sea	son	F	'irst seas	on	Se	cond sea	son
Compost Cut	10	20	Mean	10	20	Mean	10	20	Mean	10	20	Mean
Without	88.00	93.33	90.67	75.67	90.33	83.00	38.00	44.67	41.34	39.00	47.00	43.00
Cut 1	56.67	67.00	61.84	65.67	80.33	73.00	44.00	47.33	45.67	45.00	49.00	47.00
Cut 2	24.00	42.33	33.17	38.00	42.00	40.00	19.00	22.67	20.84	20.00	24.67	22.34
Mean	56.22	67.55		59.78	70.89		33.67	38.22		34.67	40.22	
L.S.D. at 5%	Com. Cut Com*cut	4.14 3.26 4.43		4.78 2.01 2.72			3.13 1.70 2.31			0.82 1.82 2.44		

Table (5). Effect of compost and number of cuttings on weight of 1000 seeds (g) of *Coriandrum sativum* L.

	We	eight of 1	000 seeds	(g)		
Treatment	Fir	st season		Se	cond seas	son
Compost Cut	10	20	Mean	10	20	Mean
Without	13.44	14.73	14.09	10.83	12.85	11.84
Cut 1	15.20	15.89	15.55	13.36	15.81	14.59
Cut 2	9.76	10.85	10.31	10.74	10.87	10.81
Mean	12.80	13.82		11.64	13.18	
L.S.D. at	Com.	0.26		0.24		
5%	Cut	0.16		0.15		
	Com*cut	0.22		0.21		

 Table (6). Effect of compost and number of cuttings on weight of seeds/plant and yield of seeds of *Coriandrum sativum* L.

		Seeds/plar	ıt (g)					Yie	ld of seed	s (kg/fedd	lan)	
Treatment	Fi	irst season		Se	cond sea	ason	F	'irst seaso	n	Se	cond seas	on
Compost Cut	10	20	Mean	10	20	Mean	10	20	Mean	10	20	Mean
Without	7.81	11.39	9.60	7.68	11.31	9.50	277.50	404.83	341.16	272.93	402.20	337.56
Cut 1	7.84	11.99	9.92	7.74	11.88	9.81	278.60	426.37	352.48	275.03	422.47	348.75
Cut 2	2.12	2.76	2.44	2.17	2.74	2.46	75.49	98.13	86.81	76.60	97.53	87.10
Mean	5.92	8.71		5.86	8.64		210.53	309.78		208.19	307.40	
	Com.	0.20		0.17			7.16			6.51		
L.S.D. at 5%	Cut	0.09		0.11			3.45			3.63		
	Com*cut	0.13		0.14			4.68			4.93		

1.4. Essential oil percentage and oil yield (L/feddan)

Data in table (7), show that essential oil percentage and oil yield (L/feddan) was significantly increased by using compost at 20 m³/feddan with one cutting during the two seasons. Same results were obtained by Hussein et al. (2010), Darzi and Hadi (2014) and Aćimović et al. (2015).

		percer	nage and	on yie.		rianarun	п ѕанчи	m L.				
	J	Essentia	l oil (%)					0)il yield (L/fedda	in)	
reatment	Firs	st seasor	n	Se	cond se	ason	F	irst sea	son	See	cond sea	ason
Compost Cut	10	20	Mean	10	20	Mean	10	20	Mean	10	20	Mean
Without	0.15	0.27	0.21	0.16	0.25	0.21	0.42	1.09	0.76	0.43	1.01	0.72
Cut 1	0.20	0.28	0.24	0.22	0.27	0.25	0.56	1.09	0.83	0.61	1.14	0.88
Cut 2	0.14	0.18	0.16	0.16	0.19	0.18	0.11	0.18	0.15	0.12	0.19	0.16
mean	0.16	0.24		0.18	0.24		0.36	0.79		0.39	0.78	
L.S.D. at	Com.	0.14		0.01			0.35			0.01		
5%	Cut	0.01		0.01			0.23			0.01		
	Com*cut	0.04		0.02			0.03			0.04		

 Table (7). Effect of compost and number of cuttings on essential oil percentage and oil yield of *Coriandrum sativum* L.

2. Chemical Composition

2.1. Total nitrogen and carbohydrate percentage

The uptake and utilization of nitrogen by *Coriandrum sativum* were affected by both compost manure and number of cuttings (Table 8). In both seasons, treated plants with high level of compost and one cutting gave the best N contents than other treatments. Similar result were obtained by Mugendi et al. (1999), showing that, application of manure combination with inorganic fertilizer enhanced herbage and N content with increase the rate of decomposition and mineralization.

Carbohydrate content showed the same trend of nitrogen as shown in table (8). The highest values of carbohydrate percentage were obtained by the application of 20 m³ compost and one cutting. Improvement in vegetative growth characters by the application of high doses of compost may have resulted in stimulation of the photosynthesis, which accumulated more carbohydrate content. As reported by Abdelaziz et al. (2007) on *Rosmarinus officinalis*, Richards (1993) and Duru and Ducrocq (2000), it was found that, increasing growth parameters by frequencies cuttings may explain the accumulation in carbohydrate.

		(70)) and car	bollyul) of Con	ипагит	sauvam	L.			
	Γ	Nitroge	en (%)					0	Carbohy	drate (%	()	
Treatment	Firs	t seaso	n	Sec	cond se	eason	Fi	irst seas	on	Sec	cond sea	ison
Compost Cut	10	20	Mean	10	20	Mean	10	20	Mean	10	20	Mean
Without	2.41	3.52	2.97	2.67	3.43	3.05	17.83	21.05	19.44	19.74	22.80	21.27
Cut 1	2.67	3.64	3.16	2.67	3.67	3.17	18.22	22.81	20.52	22.08	23.80	22.94
Cut 2	2.31	3.09	2.70	2.41	3.16	2.79	17.55	19.71	18.63	18.89	23.11	21.00
mean	2.46	3.42		2.58	3.42		17.87	21.19		20.24	23.24	
L.S.D. at	Com.	0.04		0.01			4.26			0.35		
5%	Cut	0.02		0.03			0.47			0.57		
	Com*cut	2.62		2.02			0.63			0.77		

Table (8). Effect of compost and number of cutting treatments on nitrogen(%) and carbohydrate (%) of *Coriandrum sativum* L.

2.2. Oil composition

The composition of the essential oil with $20m^3$ of compost and without cutting or one cutting is presented in tables (9 and 10). A total 28 compound were detected in essential oil. The main constituents of *Coriandrum sativum* are presented in table (9) it showed that, L-Linalool, terpinene, α –Pinene, Camphor, Geraniol, Geranyl acetate, D-Limonene and p-Cymene. The highest percentage of main component was obtained by one cutting of plant compared without cutting under the same level compost. Except, the highest value of p-Cymene was resulted without cutting plants. Same results were obtained by Hussein et al. (2010). Darzi and Hadi (2014) reported that, compost manure application through increase of mineral uptake such as nitrogen and phosphorus has a positive effect on proper biomass production and subsequently the enhanced essential oil content in seed.

No.	Compound	2 com.	Compound	2 com.
		without		1 cut
		cut %		%
1	α -Pinene	2.93	α -Pinene	4.27
2	p-Cymene	23.58	p-Cymene	2.29
3	D-Limonene	0.81	D-Limonene	1.98
4	Terpinene	3.68	Terpinene	7.83
5	L-Linalool	46.80	L-Linalool	62.64
6	Camphor	3.92	Camphor	5.97
7	1-Borneol	0.23	1-Borneol	0.30
8	Geraniol	1.30	Geraniol	3.59
9	Geranyl acetate	1.81	Geranyl acetate	5.30

 Table (9). Effect of compost and number of cuttings on oil GC-mass main compounds of *Coriandrum sativum* L.

No.	Compounds	2 com.	Compounds	2 com.
		without		1 cut
		cut %		%
10	Camphene	0.34	Camphene	0.52
11	Sabinene	0.16	Sabinene	0.29
12	a-Myrcene	0.28	a-Myrcene	0.74
13	α -Terpinolene	0.19	α -Terpinolene	0.05
14	Trans-Sabinene	0.84	Trans-Sabinene	0.18
	hydrate		hydrate	
15	1-terpineol	0.42	α -Phellandrene	0.08
16	1-Menthone	0.44	1-Octanol	0.05
17	D-menthone	0.97	α -Terpinolene	0.54
18	(-) 4-terpineol	3.63	1-4 Terpineol	0.32
19	α -Terpineol	4.21	α -Terpineol	0.58
20	p-Menth-1-en-3-ol	0.20	Decanal	0.60
21	α -Citronellol	0.20	α-Citronellol	0.36
22	p-Menth-1-en-3-ol	0.13	2-Decenal	0.13
23	Thymol	0.14	1-Decenol	0.12
24	trans-Caryphyllene	0.70	Undecanal	0.12
25	(+) spathulenol	0.28	Myrtenyl acetate	0.15
26	Caryphyllene-oxide	0.51	Dodecanal	0.31
27	Tau-Cadinol	0.77	2-Dodecanal	0.32
28	Spiro (4.5) decan-6-	0.55	2-Pentadecanone, 6,	0.10
	ol,6 methyl		10, 14-trimethyl	

 Table (10). Effect of compost and number of cuttings on oil GC-mass trace compounds of *Coriandrum sativum* L.

CONCLUSION

From the above mentioned results, it could be concluded that, application of compost manure at 20 m^3 /feddan and cutting *Coriandrum* sativum plant at 45 days after sowing give the highest growth parameters and chemical content.

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Received: 14/6/2016 Accepted: 3/10/2016

تأثير الكومبست وعدد مرات الحش على إنتاجية نبات الكسبرة تحت ظروف سيناء

وليد محد عبد العظيم قسم النباتات الطبية والعطرية، مركز بحوث الصحراء، المطرية، القاهرة، مصر

أجريت تجربتين حقليتين بمحطة بحوث المغارة بوسط سيناء والتابعة لمركز بحوث الصحراء خلال موسمي ٢٠١٥/٢٠١٤ و٢٠١٦/٢٠١٠، لدراسة تأثير إضافة مستويين من سماد الكومبست ١٠ و٢٠ متر^٦ للفدان وحش النباتات (بدون حش وحش مرة واحدة وحش مرتين). قد أظهرت النتائج ان أفضل نمو خضري (عدد الأفرع، وزن ١٠٠٠ بذرة، محصول البذور النبات وللفدان، نسبة الزيت، أفضل محتوى من النيتروجين والكربوهيدرات وتحليل مكونات الزيت الطيار) قد تحصل عليها بمعاملة النباتات بواسطة التسميد بالكومبست بمعدل ٢٠ متر^٦ / فدان مع حش النبات لمرة واحدة. بينما كان أفضل طول للنبات في نفس معدل التسميد ولكن بدون حش.