EFFECT OF ORGANIC MANURE AND BIOFERTILIZER ON CARAWAY PLANTS (*Carum carvi,* L.)

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ABSTRACT

This investigation was carried out during 1999/2000 and 2000/2001 at Barramoon Experimental Farm, Dakahlia Governorate, to study the effect of organic manure combined with biofertilizers on growth, fruit yield and essential oil content of Caraway plants. Cattle manure at three rates 6 m^3, 9 m^3 and 12 m^3 were added during the soil preparation, while biofertilizer (mixture of 1 kg/fed Nitrobein + 1 kg/fed phosphorein) was mixed with caraway seeds before sowing immediately. Cattle manure at all rates and biofertilizer increased significantly plant growth, fruit yield and oil content. The highest values were observed at 12 m^3 cattle manure application. The superiority in growth, fruit yield and essential oil content were with combination between cattle manure 9 m^3 and biofertilizer. Also, it was noted that cattle manure at all rates individually or combined with biofertilizer produced increases of oil content and carvone percentages as well as total main components (Limonene and Cacrvone) of essential oil. The best results were recorded at 9 m^3 cattle manure plus biofertilizer.

In general, organic manure and biofertilizer caused production enhancement of plants without undesirable impact on environment.

INTRODUCTION

Caraway (*Curum carvi,* L.) Family Apiaceae (umbelliferae), is an annual herb in Egypt. It occurs both wild and cultivated in central and northern Europe, Egypt, Morocco, Asturalia and China. Caraway fruits were known to Arabian physicians and probably came into use in Europe in the thirteenth century (Treas and Evans, 1998).

Caraway fruit contains 3-7 % of volatile oil, which consists of the ketone carvone and the terpene limonene, with small quantities of dihydrocarvone, carveol and dihydrocarvel, it is assayed for ketones (Treas and Evans, 1998). The fruits and oil are used in medicine for flavouring, as carminatives and antispasmodic. Also, oil is used in pharmaceutical preparations especially children nutrients (Schavenbery and Paris, 1977).

Organic and bio-fertilizers are very important sources for providing the plants with their nutritional requirements without having an undesirable impact on environment.

Organic manure contribute to plant growth through its effect on physical, chemical and biological properties of the soil as well as through its effect as a source of essential nutrients (El-Nagar, 1996).

Cattle manure increased the growth of *Ocimum bacilicum* plants (Raviv *et al.,* 1998). Aflatuni *et al.* (1993) found that the organic manure increased the dry matter yield of marjoram and peppermint plants.

As for the application of manure fertilizer and biofertilizers, Fallik and Okon (1996) and Awad (1998) reported that bacterial strains were highly efficient on promotion of nitrogen fixation, CO_2 evaluation and ammonification

resulting in adjustment of pH media than using each of them in single application.

Therefore, the objectives of this study was to investigate the effect of biofertilizer and cattle manure on the growth, fruit yield, essential oil content and oil quality of caraway plants.

MATERIALS AND METHODS

This study was established during 1999/2000 and 2000/2001 seasons in the experimental farm at Barramoon, Dakahlia Govermorate, Egypt. It aimed to study the effect of organic and biofertilizer in single or combined applications on caraway plants (*Carum carvi,* L.).

Caraway seeds were obtained from Medicinal and Aromatic plant Research Department., Dokky, Giza. The soil of the experimental field was clay loam in texture, Ec 1.29 mmhos/cm, pH 8.1, clay 56.1 %, silt 30.9 %, sand 13 %, $CaCO_3$ 3.4 %, available N 24.2 ppm, P 11.7 ppm and K 328 ppm.

Caraway seeds were sown in the experiment field on 15th October, in both seasons. The experiment was carried out in a complete randomized block design, with three replicates, involving 8 treatments as follows:

1- Control
2- Biofertilizer*
3- 6 m^3 cattle manure.
4- 9 m^3 cattle manure.
5- 12 m^3 cattle manure.
6- 6 m^3 cattle manure + biofertilizer.
7- 9 m^3 cattle manure + biofertilizer.
8- 12 m^3 cattle manure + biofertilizer.

Chemical analysis of organic manure used in both seasons is shown in Table (1).

Table (1): Chemical analysis of the used organic manure.

Fertilizer	Organic matter %	N %	P %	K %	Fe %	Mn ppm	Zn ppm	Cu ppm	Cd ppm
Cattle manure	60.9	1.01	0.80	0.70	1.33	264	98.7	87.6	2.11

The plot area was 2.5 x 4 m and contained 3 rows, each row was 4 m in length and the distance between rows 60 cm, plant spacing in the row 35 cm (30 plants per plot). All plots were supplied with calcium superphosphate 100 kg/fed and potassium sulphate 50 kg/fed during soil preparation.

Organic manure (Cattle manure) rates were applied during the soil preparation, Biofertilizer [(a commercial compound) mixture of 1 kg phosphorein + 1 kg Nitrobein per feddan] was mixed with caraway seeds before sowing immediately.

Data were recorded as follows:

Plant height cm, number of branches per plant and fresh and dry weights per plant of vegetative growth (after 135 days from sowing).

Number of umbels per plant, fruits yield per plant, per plot and per feddan as well as essential oil content at harvesting time (after 180 days from sowing).

Nitrogen, phosphorous and potassium content in dried leaves of caraway plants were estimated (after 135 days from sowing) according to A.O.A.C., 1980; Jackson, 1967 and Peterbugski, 1968 respectively.

The percentage of essential oil of fruits was determined by steam water distillation method according to the British Pharmacopoeia Method (1983). Determination of essential oil constituents was by gas liquid chromatography (G.L.C.). The used conditions were as follows:

Conditions of G.L.C.

Column	Capillary DPBS 5
Flow rate	Nitrogen I ml/min, Hydrogen 30 ml/min, air 300 ml/min
Column temp.	70 - 190 °C
Rate temp.	70-80 °C 1 °C/min (Ramp 1)
	80-110 °C 5 °C/min (Ramp 2)
	110-190 °C 1 °C/min (Ramp 3)
Injection temp.	250 °C
Detector temp.	300 °C

Data were statistically analysed according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSIONS

Plant height:

Data presented in Table (2) showed that plant height was increased significantly with increasing the rates of organic fertilizer (cattle manure) alone or in combination with biofertilizer. The highest values were obtained at 12 m^3 of cattle manure combined with biofertilizer, when compared with the other treatments.

Table (2). Effect of organic manure rates and biofertilizer on plant growth of caraway plant during 1999/2000 and 2000/2001 seasons.

Treatments	1999/2000				2000/2001			
	Plant height cm	No. of main branch-es/ plant	F.W. gm/ plant	D.W. gm/ plant	Plant height cm	No. of main branch-es/ plant	F.W. gm/ plant	D.W. gm/ plant
Control	95.3	6.63	429.21	97.65	91.3	5.33	380.10	84.00
biofertilizer	107.8	7.60	497.35	109.34	105.6	8.00	491.21	108.00
6 m^3 C.M.	104.5	7.00	458.41	100.76	101.0	7.66	439.13	93.51
9 m^3 C.M.	109.6	7.33	471.26	104.09	112.3	8.00	452.90	99.45
12 m^3 C.M.	119.6	7.66	512.17	112.67	117.6	8.00	527.27	116.00
6 m^3 C.M. + bio.	110.3	8.66	531.90	117.02	115.0	8.33	543.15	120.04
9 m^3 C.M. + bio.	120.6	8.66	567.00	124.74	123.6	8.66	580.15	129.39
12m^3 C.M. + bio.	130.0	8.33	590.23	129.85	129.6	8.66	582.20	129.83
LSD at 5 %	2.48	0.03	6.34	0.89	4.52	0.02	2.67	1.56

C.M. = cattle manure

The increase in plant height could be attributed to the effect of substractes on the improvement of chemical and physical properties of the soil as mentioned by Rumple (1998). These results were in agreement with the previous results of Widjajanto and Widodo (1982), who cleared that increasing the rates of farmyard manure increased plant height.

Number of main branches:

Data in the same Table (2) showed that organic manure at all rates increased number of main branches. Also, organic manure combined with biofertilizer was more effective in increasing number of main branches than each individual application. The obtained results were in harmony with those reported by Kostove *et al.* (1991) who mentioned that organic manure and interaction between nitrogen fixing bacteria and phosphobacteria showed significant increase in plant growth and fresh and dry weights comparing with individual application on tomato plants.

Fresh and dry weights:

Plant growth as indicated by vegetative fresh and dry weights of caraway throughout the experimental period were presented in Table (2). The data showed that, all treatments increased fresh and dry weights during the two seasons. The highest values were obtained with 12 m^3 organic manure combined with biofertilizer application.

These results may be related to organic manure and biofertilizer that promoted the plant growth through its effect on physical, chemical and biological properties of the soil as well as through its effect as a source of essential nutrients (El-Nagar, 1996). These results were also in agreement with the previous results of Fallik and Okon (1996) and Raviv *et al.* (1998) who found that the organic manure increased the dry matter yield of marjoram and peppermint plants.

Number of umbels per plant:

Data in Table (3) cleared that number of umbels per plant was increased due to the application of organic manure alone or in combination with biofertilizer. The increments tended to correlate with increasing organic manure rates. The highest values were obtained with organic manure ($9m^3$) addition combined with biofertilizer. The increment of the number of umbles per plant may be owing to the increase of number of main branches. Similar results were obtained by Khater (2001) on caraway plants.

Fruit yield:

Data in Table (3) indicated that, application of organic manure alone or with biofertilizer increased significantly fruit yield per plant, per plot and per feddan. These increments were more than those obtained in the cases of organic manure rates and biofertilizer each of them applied lonely. Organic manure is a very important source for providing the plants with their nutritional requirements and improved the properties of the soil. Besides, the role of biofertilizer may be leading to superiority in fruit yield. The maximum values were recorded at 9 m^3 organic manure combined with biofertilizer. Similar results were mentioned by Khater (2001) on caraway plants and Dawa *et al.* (2000) on tomato plants.

Table (3). Effect of organic manure rates and biofertilizer on number of umbels per plant and fruit yield of caraway plants during two seasons of 1999/2000 and 2000/2001.

Treatments	1999/2000				2000/2001			
	No. of umbels /plant	Fruit yield gm /plant	Fruit yield kg/plot	Fruit yield kg/fed	No. of umbels /plant	Fruit yield gm /plant	Fruit yield kg/plot	Fruit yield kg/fed
Control	32.00	44.80	1.344	537.60	30.66	41.084	1.232	493.01
biofertilizer	38.33	57.49	1.725	689.94	39.00	56.55	1.696	678.60
6 m^3 C.M.	35.00	54.25	1.627	651.00	34.33	49.09	1.473	589.10
9 m^3 C.M.	37.66	57.99	1.740	695.95	39.33	56.63	1.699	679.62
12 m^3 C.M.	42.00	64.26	1.928	771.12	41.66	59.57	1.787	714.88
6 m^3 C.M. + bio.	40.33	58.48	1.754	701.74	41.00	59.45	1.783	713.40
9 m^3 C.M. + bio.	46.00	67.16	2.015	801.92	43.6	63.22	1.897	758.64
12m^3 C.M. + bio.	45.00	64.35	1.930	722.20	43.00	61.92	1.858	743.04
LSD at 5 %	1.26	1.98	0.120	-	0.93	1.76	0.091	-

C.M.= cattle manure

Chemical analysis

N, P and K concentration:

Data in Table (4) showed that N, P and K concentrations in caraway dried leaves were increased with organic manure rates and biofertilizer application. These increments tended to be relationship with the increasing rates of organic manure fertilizer.

Table (4). Effect of organic manure rates and biofertilizer on N, P and K in dry leaves tissue of caraway plants in 1999/2000 and 2000/2001 seasons.

Treatments	Mineral composition					
	1999/2000			2000/2001		
	N %	P %	K %	N %	P %	K %
Control	1.91	0.24	1.80	2.10	0.26	1.82
biofertilizer	1.93	0.38	1.85	2.13	0.39	1.95
6 m^3 C.M.	1.96	0.31	1.91	2.26	0.28	1.98
9 m^3 C.M.	1.98	0.33	1.93	2.17	0.32	1.98
12 m^3 C.M.	2.01	0.36	1.98	2.21	0.37	2.15
6 m^3 C.M. + bio.	2.10	0.36	1.98	2.11	0.36	2.17
9 m^3 C.M. + bio.	2.15	0.38	2.01	2.51	0.39	2.21
12m^3 C.M. + bio.	2.13	0.38	2.11	2.49	0.36	2.19

C.M.= cattle manure

In the same Table (4), it was noticed that organic manure rates combined with biofertilizer gave a high values of the percent of N, P and K without having an undesirable impact on environment. These results could explain the role of phosphate dissolving bacteria in converting P fixed form to be soluble ready available for plant nutrition and may be due to the N supplementary effect of N fixing bacteria, as well as the role of the bacteria in the production of auxins (Zahir *et al.,* 1997). These results agreed with those reported by Kostov *et al.* (1991) and El-Saadany and AbdelRasoul (1999).

Essential oil content:

Data presented in Table (5) showed that application of organic manure rates only or with biofertilizer increased the essential oil percentage in fruits of caraway plant at all rates. The highest percentage was obtained with organic manure at 9 m^3 combined with biofertilizer. These results were in agreement with those obtained by El-Ghadban (1998) who reported that organic manure caused significant increase in essential oil percentage of spearmint plants. Also, in the same Table, it was cleared that oil yield ml/plant and liter/feddan as affected by organic manure rates as well as combined with biofertilizer were increased, these increments tended with the increasing rates. The maximum values were recorded at 9 m^3 organic manure plus biofertilizer.

Table (5). Effect of organic manure rates and biofertilizer on essential oil percentage, oil yield ml/plant and oil yield liter/fed in fruits of caraway plants during two seasons of 1999/2000 and 2000/2001.

Treatments	Oil percentage %		Oil yield ml/plant		Oil yield liter / feddan	
	99/2000	2000/2001	99/2000	2000/2001	99/2000	2000/2001
Control	1.20	1.22	0.538	0.501	6.451	6.015
biofertilizer	1.47	1.50	0.845	0.848	10.142	10.179
6 m^3 C.M.	1.40	1.43	0.760	0.702	9.114	8.424
9 m^3 C.M.	1.61	1.52	0.934	0.866	11.205	10.330
12 m^3 C.M.	1.60	1.61	1.082	0.959	12.334	11.560
6 m^3 C.M. + bio.	1.61	1.58	0.942	0.939	11.298	11.272
9 m^3 C.M. + bio.	1.65	1.72	1.108	1.087	13.232	13.049
12m^3 C.M. + bio.	1.61	1.67	1.036	1.034	12.432	12.409
LSD at 5 %	0.07	0.02	0.011	0.013	-	-

C.M.= cattle manure

This increment might be attributed to the enhancing effect of the mentioned treatments on plant growth i.e. number of main branches, number of umbels, fruit yield as well as oil percentage. These results coincided with Khater (2001) on caraway plant and El-Ghadban (1998) on spearmint and marjoram plants.

Essential oil components:

Data in Table (6) and Fig. (1) showed that caraway oil containes limonene and carvone as main components. Also, it was noticed that organic manure at all rates and biofertilizer increased the percentages of carvone, while the applications of organic manure rates individually or combined with biofertilize induced differences in the percentages of Limonene when compared with the untreated plants (control).

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The best value of the percentage of Carvone (56.95) was obtained in plants treated with organic manure at 9 m^3 combined with biofertilizer.

As for the total percentage of the two main components (Limonene + Carvone) it was increased in all treatments. The highest value (97.95 %) was recorded at 9 m^3 organic manure plus biofertilizer. These results are in harmony with those found by Khater (2001) who mentioned that organic manure and biofertilizer increased the main components of caraway plants.

Table (6). Effect of organic manure rates and biofertilizer on the percentage of main components (Limonene and Carvone) in the essential oil of caraway fruits in 2000/2001 season.

Treatments	Oil components			
	Limonene	Carvone	Limonene + Carvone	Other components
Control	41.01	52.08	93.09	6.91
biofertilizer	42.57	54.46	97.03	2.97
6 m^3 C.M.	40.37	52.71	93.08	6.92
9 m^3 C.M.	43.74	54.02	97.76	2.24
12 m^3 C.M.	40.36	54.85	95.21	4.79
6 m^3 C.M. + bio.	43.72	53.30	97.02	2.98
9 m^3 C.M. + bio.	41.00	56.95	97.95	2.05
12m^3 C.M. + bio.	41.15	56.60	97.75	2.25

C.M.= Cattle manure

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دراسة تأثير التسميد العضوى والحيوى على الكراوية

طه أحمد طه عبد اللطيف

قسم بحوث النباتات الطبية والعطرية بمعهد البساتين

أجريت هذه التجربة بمزرعة البرامون البحثية بمحافظة الدقهلية والتابعة لمعهد بحوث البساتين بوزارة الزراعة بهدف استخدام التسميد العضوى والحيوى كبديل للتسميد الكيماوى ومدى تأثيره على النمو الخضرى والإنتاج ونسبة الزيت ومكوناته لنبات الكراوية وذلك للحصول على محصول آمن من حيث التركيب وعالى الجودة مع ضمان عدم تلوث البيئة.

وقد استخدم فى هذا البحث ثلاث معدلات من سماد الماشية (٦ ، ٩ ، ١٢ م^{٣}) للفدان منفردا أو مع السماد الحيوى ، والسماد الحيوى المستخدم عبارة عن مخلوط من مركبات الفوسفورين والنيتروبين بمعدل ١ كجم/فدان لكل منهما.

وكانت النتائج كالآتى:

١ـ أدى استخدام السماد العضوى والحيوى منفردين إلى زيادة فى النمو الخضرى مثل ارتفاع النبات وعدد الأفرع الرئيسية والوزن الطازج والجاف وأيضا عدد النوارات وكمية المحصول ونسبة الزيت وكانت أفضل النتائج عند استخدام السماد العضوى بمعدل ١٢ م^{٣}/فدان.

٢ـ ظهرت عند استخدام السماد العضوى والحيوى معا أعلى النتائج وكان أفضلها عند معدل ٩ م^{٣} سماد عضوى/فدان سماد عضوى مع التسميد الحيوى.

٣ـ لوحظ زيادة معنوية فى النسبة المئوية ومحصول الزيت للنبات وكذلك للفدان باستخدام التسميد العضوى والحيوى.

٤ـ زيادة النسبة المئوية للمكونات الرئيسية للزيت (ليموتين + كرفون) فى جميع المعاملات وكانت أفضلها ٩٧,٩٥ % عند المعاملة ٩ م^{٣} سماد عضوى/ فدان مع التسميد الحيوى وأيضا كانت أعلى نسبة للكرفون ٥٦,٩٥% فى نفس المعاملة عند المقارنة بباقى المعاملات والكنترول.