

INFLUENCE OF BIOFERTILIZERS ON GROWTH, VOLATILE OIL YIELD AND CONSTITUENTS OF FENNEL (*FOENICULUM VULGARE*, MILLER) PLANT

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Abstract

Two field experiments were carried out at Baramoon Experimental Station, Dakahlia Governorate, Egypt, during the two successive seasons of 2003-2004 and 2004-2005 to study the effect of Bio Effective Microorganisms (EM₁), askobein, microbein, biogein and ammonium sulphate at the rate of 150 kg/Fed. The results were as follow:

Biogein followed by microbein, ascobein and ammonium sulphate, respectively, compared with untreated plants enhanced all measurements such as plant height, number of branches, number of umbels, weight of fruits (per plant and per plot), volatile oil percentage, volatile oil yield (per plant and per plot), the main component of fennel volatile oil (anethole) was increased in the two seasons in comparison with control plants.

The combinations of EM₁ with each of biogein, microbein, ascobein and ammonium sulphate were more effective on all traits studied than each individual treatment in both seasons.

(EM₁) application individually achieved results better than obtained by biogein, microbein, ascobein and ammonium sulphate individually, on the other hand, combination of EM₁ with each of biogein, microbein, ascobein or ammonium sulphate, respectively, were the best applications in both two seasons.

INTRODUCTION

Fennel (*Foeniculum vulgare*, Miller) is one of the most important annual plants which belongs to family Apiaceae (Umbelliferae). It is cultivated as medicinal and aromatic plant, it has small yellow flowers on large umbels, and their fruits vary in size and appearance. The fruits are greenish, yellowish brown or in gray-brown color.

Since the ancient Egyptians, fennel has been used in several forms as a fresh or dried leaves, dried ripe fruits and volatile oil. The distilled oil or its infusion is used as aromatic carminative, stimulant, condiment. The yellow pigmentation substance is also extracted from fennel plants for the above objectives.

The fruits contain 2 to 6% volatile oil according to different varieties. The constituents of essential oil are about 60% of anethole and 20% of ketone fenchone, which characterized the fruits by special odor and taste beside other components. The fruits contain 10% of fixed oil. The medical properties of oil are motivating, carminative, stomachic, expectorant, diuretic, galactenic and antispasmodic. Fruits are used as infusion and tinctures (Ferdinand, 1977).

The impact of green parties' activities over the world has imposed a new thought against chemical fertilization and has encouraged biofertilization and natural production of food crops. This tendency is emphasized on medicinal plants, since they are the main source for a major part of treatment drugs.

In response to this movement, the Ministry of Agriculture and Lands Reclamation, Egypt contributes in supplying several products that concert with the natural production and biofertilization. Among these products Biogein and Microbein, are trading mixtures containing nitrogen fixing bacteria, while EM₁ is another mixture containing Photosynthetic bacteria, lactic acid producing bacteria and yeast. Askobein is bio-product has mechanisms for plant growth activator.

Several workers tended to utilizing natural and biofertilizers instead of chemical compounds to avoid the side effects of the latter substances for medicinal, food and aromatic plants. On okra, Oblisami *et al.* (1977), on wheat, Kavimandan (1986), on Ononis spp., Kolomietes (1978), on palmarosa, Maheshwari *et al.* (1995), on bhendi plant, Sankoranayanan *et al.* (1995), on roselle, Harridy and Mervat (1998) and on lemongrass, Harridy *et al.* (2001) found benefit effects of biofertilization and other nutrition of bio-compounds on yield and other economic traits of Lemongrass. Saber (1996) attracted the attention to the importance of using some modern nutrients (biofertilizers) aiming to increase the number of effective microorganisms, to accelerate certain microbial processes and to augment the extent of the availability of nutrients in a suitable form that can be easily assimilated by plants. These microorganisms which are used as bio-fertilizers induce comfortable effects on plant growth and its productivity via fixing the atmospheric nitrogen in suitable nutrition materials.

This study was carried out to evaluate the effect of modern biotechnology fertilizers (EM₁), biogen, Microbein and Askobein comparing with ammonium sulphate on growth, yield and essential oil of fennel plant.

MATERIALS AND METHODS

Two experiments were carried out at the experimental farm of Baramoon Station, Dakahlia Governorate, Agriculture Research Center (ARC) during the seasons of 2003-2004 and 2004-2005. The chemical analysis of the soil was done at Water and Soil Laboratory at Mansoura, using standard method described by Jackson (1967). The obtained analysis is shown in Table (1).

Table 1. The physical and chemical analysis of the experiment soil.

Sand %	Silt %	Clay %	CaCO ₃ %	pH	Available nutrients (ppm)		
					N	P	K
24.6	30.2	42.6	3.2	7.4	13.9	11.6	32.7

The Medicinal and Aromatic plant Research Department, Horticulture Research Institute, ARC, was the source of fennel variety used. The seeds were sown in the field at 15th October in both seasons.

The experiments were in split-plots design with three replicates. The main plots were two levels of EM₁ (with and without spray), and the sub plots were five treatments as follow: 1-the control without any treatment, 2- askobein which is a natural activator growth empty of hormones but contains nutritional organic substances for plants at percentage of 62 % nearly, the active substance of askobein is ascorbic acid and citric acid at 38 % percentage, nearly, 3- microbein is a mixture containing nitrogen fixing bacteria (*Pseudomonas fluorescens*), 4- biogein is a mixture containing nitrogen fixing bacteria (*Azotobacter sp.*) and 5- ammonium sulphate. EM₁ is a trading mixture containing Photosynthetic bacteria, lactic acid producing bacteria and yeast.

Askobein was foliage sprayed after one month of sowing. Ammonium sulphate was added during soil preparation before sowing. Both micrbein and biogein were applied to inoculate fruits before sowing, also. EM₁ was sprayed after 40 days of sowing when plants were full vegetative growth.

Each plot contained 5 rows in 60 cm width and 2.5 m in length and 25 cm apart hills. The area of each plot was 3 x 2.5 m = 7.5 m². The plants did not receive any chemical fertilizers and all the agricultural practices were performed as fennel recommendations.

Plants were harvested on 3rd May. The following data were recorded: plant height, number of branches, number of umbels, weight of fruits per plant and per plot, volatile oil percentage and volatile oil yield per plant and per plot and estimation main component of volatile oil (anethole) by GLC analysis in two seasons.

The percentage of volatile oil was determined according to the method described in British Pharmacopoeia (1963).

G. L. C. analysis was carried out in the Central Laboratory of Horticultural Research Institute, Agricultural Research Center. The following conditions were used for the GLC analysis,

Carbowax 20 m

25 m x 0.3 mm capillary of slow rates

N₂ 2 ml/min

Air 330 ml/min

H₂ 30 ml/min

Injection temp 250 °C

Program 50-200 °C /min

Held 10 min at 200 °C

The collected data were statistically analyzed according to Steel and Torrie (1980). The least significant difference (LSD) was used to compare between treatments means.

RESULTS AND DISCUSSION

Vegetative growth characters:

1. Plant height:

Data shown in Table (2) represent plant height response to different treatments. These results of the first season revealed that the average plant height of fennel plants were 179.2, 229.5, 234.2 and 245.6 cm for ammonium sulphate, askobein, microbein and biogein individually or without EM₁, respectively. All these treatments significantly increased plant height than the control. But the less increment observed by the chemical fertilizer. Askobein gave an increment significantly more than the ammonium sulphate but significantly less than both microbein and biogein which are nitrogen fixing mixtures. Nearly, the same trend was observed in the second season.

Plants received EM₁ individually were significantly taller than those hadn't any treatments in both seasons. On average the combinations between EM₁ and other treatment gave plants significantly had more height than their counterparts. These results indicated that plants which received (EM₁) fertilization spraying on leaves interacted with different fixing nitrogen mixture (biogein and microbein) as well as the nature organic materials (askobein) to apparently increases plant height than (EM₁) or other fertilizers individually. The combination between (EM₁) and biogein showed the best increment in two seasons (302.4 and 307.6 /cm) respectively compared with other combinations.

Table 2. Influence of biofertilizers and their interactions on plant height (cm) of fennel plant during two seasons 2003/2004 and 2004/2005.

Kind of fert. (A)	(B)					Means of (A)
	0	Askobein,	Microbein	Biogein	Ammonium sulphate	
2003/2004						
Control	168.7	229.5	234.2	245.6	179.2	211.4
EM ₁	275.8	288.6	291.3	302.4	267.6	285.1
Mean of (B)	222.2	259.0	262.8	274.0	223.4	
LSD at 5%	F-Test for A = ** B = 6.4 A x B = 9.1					
2004/2005						
Control	162.7	219.3	225.1	237.6	170.2	203.0
EM ₁	278.7	291.0	296.7	307.6	269.2	288.6
Mean of (B)	220.0	255.1	260.9	272.6	219.7	
LSD at 5%	F-Test for A = ** B = 7.1 A x B = 10.2					

Stimulation effect of both (EM₁) and (biogein) –biofertilization may be attributed to the positive effective of micro-organisms which protect the soil fertility in different ways i.e. enzymes production which solve complex organic materials, stimulation of acids and chelating agents which known as siderophores, oxidation of unsolved sulpheric components, improvement soil structure, help to create Humus and increasing of water holding capacity. Results of both the two seasons behaved in the same manner of those obtained by Saber (1996).

2- Number of branches:

Table (3) showed number of branches of fennel plants received different biofertilizers during two successive seasons. The results revealed that using biofertilizers, i. e. biogein and microbein, also askobein spraying on leaves and modern biology fertilizer in term of (EM₁) beside chemical source of N-fertilizer as ammonium sulphate, caused significant increments of number of branches per plant. Treated plants achieved clearly increment of this character as compared with the untreated control plants. Moreover, the highest value was realized when plants received (EM₁) associated with biogein followed by the combination of EM₁ with microbein compared with the other treatments.

From the same data, the treatments (EM₁) combined with each of biogein, microbein, askobein and ammonium sulphate had more stimulative effect on branching than using biogein, microbein, askobein and ammonium sulphate individually. The lowest values were given by untreated plants. Generally, (EM₁) as a source of many strains of useful bacteria realized most beneficial effects on branching habit, than either biofertilizers biogein or microbein when dressed individually.

Table 3. Influence of biofertilizers and their interactions on number of branches of fennel plant during two seasons 2003/2004 and 2004/2005.

Kind of fert. (A)	(B)					Means of (A)
	0	Askobein	Microbein	Biogein	Ammonium sulphate	
2003/2004						
Control	8.0	8.7	9.1	9.8	7.9	8.7
EM ₁	11.9	12.3	12.5	12.7	10.5	12.0
Mean of (B)	9.9	10.5	10.8	11.3	9.2	
LSD at 5%	F-Test for A = ** B = 0.7 A x B = NS					
2004/2005						
Control	6.8	8.2	9.0	9.6	7.6	8.2
EM ₁	11.8	12.3	12.6	12.8	10.1	11.9
Mean of (B)	9.3	10.3	10.8	11.2	8.9	
LSD at 5%	F-Test for A = ** B = 0.8 A x B = NS					

These results clearly emphasized that biological fertilization in term of modern fertilizer (EM₁) or biofertilizers i.e., biogein and microbein caused more increasing effect on branching than ammonium sulphate. Actually, natural source of fertilizers established efficiency on safety manner for soil fertility and unpolluted environment, in oppositely influence by different chemical fertilizers.

It is evident from data recorded in Table (3) that average number of branches per plant increased with inoculation by biofertilizers materials and spraying (EM₁), either individual or in combinations, comparing with untreated plants. These results are in harmony with those obtained by Awad (1998).

3- Number of umbels per plant:

Data recorded in Table (4) showed average umbels numbers of fennel plant treated by EM₁, askobein, microbein, biogein and ammonium sulphate individually and in combination. The results revealed that (EM₁), microbein and biogein, ammonium sulphate askobein had significant effects toward increasing number of umbels of fennel plants in the two seasons of application.

Table 4. Influence of biofertilizers and their interactions on number of fennel plant umbels during two seasons 2003/2004 and 2004/2005.

Kind of fert. (A)	(B)					Means of (A)
	0	Askobein	Microbein	Biogein	Ammonium sulphate	
2003/2004						
Control	30.6	38.6	40.7	45.3	35.8	38.2
EM ₁	50.8	54.9	58.5	67.7	48.7	56.1
Mean of (B)	40.7	46.8	49.6	56.5	42.3	
LSD at 5%	F-Test for A = ** B = 1.5 A x B = 3.1					
2004/2005						
Control	32.0	37.5	42.6	47.0	34.2	38.7
EM ₁	44.2	49.7	53.9	66.5	40.3	50.9
Mean of (B)	38.1	43.6	48.3	56.8	37.3	
LSD at 5%	F-Test for A = ** B = 2.3 A x B = 3.3					

The best result was obtained when plants treated with the combinations of (EM₁) plus biogein followed with combination of (EM₁) plus microbein when compared with other treatments and control plants in the two seasons.

The combination of (EM₁) and each of biogein, microbein, askobein and ammonium sulphate revealed the increment in umbel number/plant than (EM₁) individually in both of the two seasons and the differences between the treatments were statistically significant. These results are in agreement with Martin *et al.* 1989, Nieto and Frankenberger, 1990 and Jacnow *et al.* 1991.

4- Fruit yield per plant and per plot:

Data presented in both Tables (5 and 6) explain that all treatments significantly increased the yield of fennel fruits per plant and per plot compared to the control in the two seasons.

The highest yield of fennel fruits per plant and per plot were obtained when the plants received the treatment of (EM₁) combined with biogein. While the combination of (EM₁) with microbein followed by the combination of (EM₁) with askobein. EM₁ combined with ammonium sulphate showed the same trend. These results were observed during the two seasons. The stimulation effect of different treatments may be due to the active function of micro-organisms on one side and the active effect of biofertilizers on other side by enhancing root growth and secreting growth promoting factors, e.g. cytokinine like substances and auxin. The obtained results agreed with those obtained by Saber (1996).

Table 5. Influence of biofertilizers and their interactions on the weight of fruits (g/plant) of fennel during two seasons 2003/2004 and 2004/2005.

Kind of fert. (A)	(B)					Means of (A)
	0	Askobein	Microbein	Biogein	Amm.sulphate	
2003/2004						
Control	69.9	85.3	89.9	96.7	78.6	84.1
EM ₁	107.2	115.6	119.2	125.6	100.0	113.5
Mean of (B)	88.6	100.4	104.6	111.2	89.3	
LSD at 5%	F-Test for A = ** B = 4.2 A x B = NS					
2004/2005						
Control	65.4	84.6	89.1	98.9	75.2	82.6
EM ₁	105.3	113.2	119.9	123.9	99.6	112.4
Mean of (B)	85.4	98.9	104.5	111.4	87.4	
LSD at 5%	F-Test for A = ** B = 3.7 A x B = NS					

The volatile oil production:

Data in Tables (7, 8 and 9) emphasized that all treatments significantly increased volatile oil percentage of fruits, volatile oil yield per plant and per plot during the two growing seasons. The application of combination between (EM₁) and biogein produced the highest volatile oil percentage, volatile oil yield per plant and per plot comparing with other treatments and control plants during the two seasons. The combinations of all factors under study realized the best values of volatile oil percentage, volatile oil yield (per plant and per plot) compared with the same factors individually and control plants during the two seasons.

Table 6. Influence of biofertilizers and their interactions on the weight of fruits (kg/plot) of fennel plant during two seasons 2003/2004 and 2004/2005.

Kind of fert. (A)	(B)					Means of (A)
	0	Askobein	Microbein	Biogein	Ammonium sulphate	
2003/2004						
Control	1.911	2.719	2.874	2.986	2.515	2.601
EM ₁	3.571	3.690	3.814	4.019	3.202	3.659
Mean of (B)	2.741	3.205	3.344	3.503	2.859	
LSD at 5%	F-Test for A = ** B = 0.009 A x B = 0.013					
2004/2005						
Control	1.591	2.632	2.888	2.990	2.412	2.503
EM ₁	3.112	3.415	3.632	4.123	2.920	3.440
Mean of (B)	2.352	3.023	3.260	3.556	2.666	
LSD at 5%	F-Test for A = ** B = 0.011 A x B = 0.015					

The biofertilizers improve the growth and quality of the product and this may be due to the effective role of biofertilizers in improving the growth of the plant,

The biofertilizers improve the growth and quality of the product and this may be due to the effective role of biofertilizers in improving the growth of the plant, consequently, the yield (quantitative and qualitative) as it improves soil properties and providing the plants with (micro and macro) nutrient elements which are essential for biosynthesis reactions in plant.

Table7. Influence of biofertilizers and their interactions on volatile oil percentage of fennel plant during two seasons 2003/2004 and 2004/2005.

Kind of fert. (A)	(B)					Means of (A)
	0	Askobein	Microbein	Biogein	Ammonium sulphate	
2003/2004						
Control	2.71	2.98	3.21	3.56	2.85	3.06
EM ₁	3.97	4.17	4.37	4.62	3.81	4.19
Mean of (B)	3.34	3.58	3.79	4.09	2.83	
LSD at 5%	F-Test for A = ** B = 0.10 A x B = NS					
2004/2005						
Control	2.73	2.97	3.25	3.59	2.81	3.07
EM ₁	3.91	4.19	4.39	4.61	3.82	4.18
Mean of (B)	3.32	3.58	3.82	4.10	3.32	
LSD at 5%	F-Test for A = ** B = 0.11 A x B = NS					

These results were found to be in harmony with those reported by Waksman (1952) and Ismail *et al.* (1988). Generally, it could be concluded that the recorded increments in growth as well as yield may be produced by the phytohormones effects, some organic acids and nutrients which stimulated absorption of nutrients from soil then stimulate the growth and the activation of materials production was expected. These results hold true in the two seasons and were found to be in accordance with those of Gomaa (1989) and Saber (1994).

Table 8. Influence of biofertilizers and their interactions on volatile oil yield (ml/plant) of fennel plant during two seasons 2003/2004 and 2004/2005.

Kind of fert. (A)	(B)					Means of (A)
	0	Askobein	Microbein	Biogein	Ammonium sulphate	
2003/2004						
Control	1.89	2.54	2.89	3.44	2.24	2.60
EM ₁	4.26	4.82	5.21	5.80	3.81	4.78
Mean of (B)	3.08	3.68	4.05	4.62	3.02	
LSD at 5%	F-Test for A = ** B = 0.24 A x B = 0.33					
2004/2005						
Control	1.79	2.51	2.90	3.55	2.12	2.57
EM ₁	4.12	4.75	5.26	5.71	3.80	4.73
Mean of (B)	2.96	3.63	4.08	4.63	3.01	
LSD at 5%	F-Test for A = ** B = 0.07 A x B = 0.10					

Table 9. Influence of biofertilizers and their interactions on volatile oil yield (ml/plot) of fennel plant during two seasons 2003/2004 and 2004/2005.

Kind of fert. (A)	(B)					Means of (A)
	0	Askobein	Microbein	Biogein	Ammonium sulphate	
2003/2004						
Control	51.79	81.03	92.26	106.30	71.68	79.59
EM ₁	141.77	153.87	166.67	185.68	122.00	153.31
Mean of (B)	91.55	114.74	126.74	143.27	80.91	
LSD at 5%	F-Test for A = ** B = 1.30 A x B = 1.80					
2004/2005						
Control	43.43	78.17	93.86	107.34	67.78	76.87
EM ₁	121.68	143.09	159.44	190.07	111.54	143.79
Mean of (B)	78.09	108.22	124.53	145.80	88.51	
LSD at 5%	F-Test for A = ** B = 2.90 A x B = 4.10					

Anethole percent in fennel volatile oil:

Data presented in Table (10) and illustrated in figures (1 and 2) showed results of applications of (EM₁), askobein, microbein, biogein, ammonium sulphate and their interactions on anethole level in the volatile oil estimated by gas liquid chromatography. The following results were obtained:

Influence of biofertilizers and their interactions on anethole:

It is observed from the results that the applications of askobein, microbein, biogein and ammonium sulphate solely resulted in an increase of anethole than obtained in the control. biogein recorded the highest value in comparison with the remain treatments solely followed by microbein, askobein and ammonium sulphate, respectively.

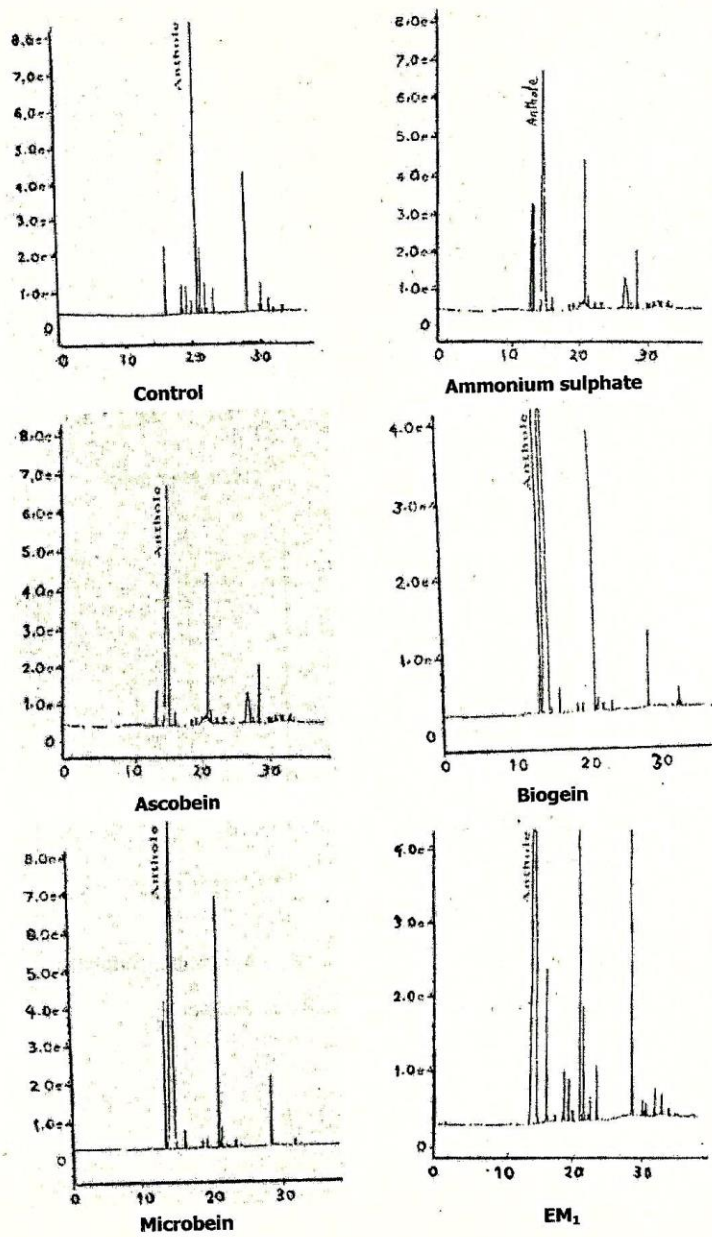
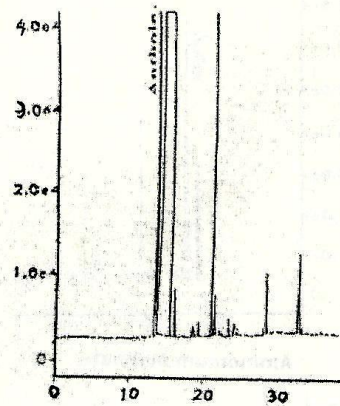
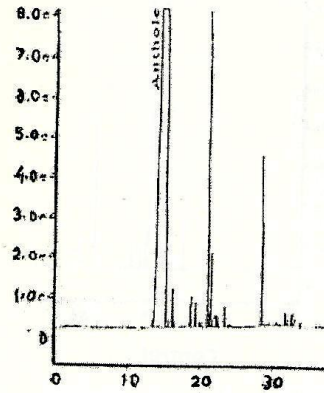


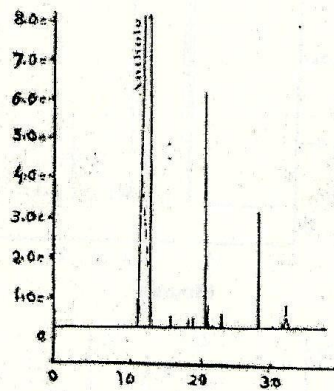
Fig. 1. GLC analysis of *Foeniculum vulgare* volatile oil.



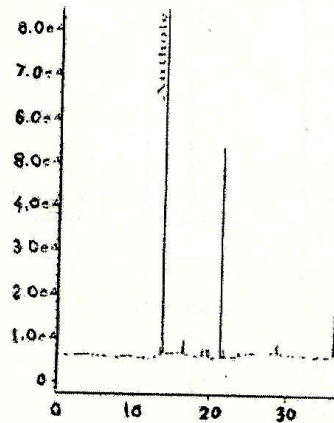
EM₁ + Ascobain



EM₁ + Microbein



EM₁ + Biogein



EM₁ + Ammonium sulphate

Fig. 2. GLC analysis of *Foeniculum vulgare* volatile oil.

With respect of the effect of (EM₁) and its combinations with askobein, microbein, biogein and ammonium sulphate on anethole content, it could be noticed from results recorded in Table (10) that anethole contents achieved best results when (EM₁) applied individually or in combinations with askobein, microbein, biogein or ammonium sulphate compared with the control value or remain treatments.

Table 10. Influence of biofertilizers and their interactions on anethole percent of fennel fruits of volatile oil obtained from GLC chromatograms.

Treatments	Control					EM ₁				
	0	Askobein	Microbein	Biogein	Amm. sulphate	0	Askobein	Microbein	Biogein	Amm. sulphate
Anethole %	58.09	65.93	71.08	80.01	63.62	83.09	88.6	90.20	92.05	80.56

In conclusion, the application of (EM₁) interacted with the other studied factors realized better than results that obtained when the studied factors were applied solely. These positive effects may be due to the stimulating effect of the studied factors on the growth and active materials of the plant. The greatest co-operated mode of action between different organisms to produce useful nutrition for fennel plants as mentioned in the scientific publication of EM₁, in addition to the efficiency effect of *Sacharomyces cerevisiae* bacteria which it is a normal growth activator would be realized. The highest value of anethole was obtained when plants were treated with (EM₁) associated by biogein followed by combinations of (EM₁) interacted with microbein, askobein, biogein and ammonium sulphate, respectively. These results were in accordance with those reported by Harridy and Mervat 1998 and Harridy *et al.* 2001.

RECOMMENDATION

Effective micro-organisms especially (EM₁) as a natural product of Ministry of Agriculture, in addition to biofertilizers such as biogein and microbein, beside askobein as a natural activator growth empty of hormones, can be used to enhance the vegetative growth and to give high yield of fennel fruits with good quality without using chemical fertilization. The application of (EM₁) associated with biogein mostly increased the main constituents of the volatile oil obtained from fennel fruits.

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تأثير الأسمدة الحيوية على النمو ومحصول الزيت الطيار ومكوناته فى نبات الشمر

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تمت هذه الدراسة فى مزرعة البرامون بمحافظة الدقهلية التابعة لإدارة بحوث البساتين خلال موسمي ٢٠٠٣/٢٠٠٤، ٢٠٠٤/٢٠٠٥ واستخدم فيها السماد الحيوى الحديث (EM₁) بالإضافة لمصادر أخرى للتسميد النيتروجينى الحيوى مثل البيوجين والميكروبيين ومنشط نمو هو الأسكوبين وأخرى نيتروجين كيمواى مثل سلفات الأمونيوم بمعدل ١٥٠ كجم/فدان على نبات الشمر مقارنة بالنباتات غير المعاملة وقد حققت النتائج الآتية:-

أدى الرش بالسماد الحيوى الحديث (EM₁) والأسمدة الحيوية البيوجين والميكروبيين والرش بالأسكوبين كمنشط نمو وسلفات الأمونيوم بمعدل ١٥٠ كجم/فدان من إلى زيادة معنوية فى طول النبات وعدد الأفرع الجانبية وعدد الثمار ووزن الثمار على النبات وفى القطعة التجريبية وأعلى نسبة مئوية للزيت الطيار فى النبات وفى القطعة التجريبية لنبات الشمر مقارنة بنباتات الكنترول.

حقق الرش باستخدام (EM₁) أفضل النتائج بالنسبة للصفات تحت الدراسة لنباتات الشمر تلاها التلقيح بالبيوجين ثم التلقيح بالميكروبيين ثم الرش بالأسكوبين تلاه سلفات الأمونيوم كل منهم منفردا بينما حققت المعاملة بكل من (EM₁) + بيوجين أفضل النتائج تبعه المعاملة بكل من (EM₁) + ميكروبيين ثم المعاملة بكل من (EM₁) + أسكوبين ثم التفاعل (EM₁) + سلفات الأمونيوم فى موسمي الدراسة وذلك عند مقارنة بين المعاملات ببعضها البعض من جهة وبين المعاملات ونباتات الكنترول من جهة أخرى.

كانت أعلى قيم للمكون الرئيسى فى الزيت مركب الإثنول عند معاملة النباتات بالسماد الحيوى الحديث (EM₁) منفردا تلاه البيوجين ثم الميكروبيين ثم الأسكوبين ثم سلفات الأمونيوم والمعاملة المزدوجة بكل من (EM₁) + بيوجين أعلى قيم للإثنول مقارنة بباقي المتفاعلات ونباتات الكنترول.