Effect of Organic, Bio- and Chemical Fertilization on Vegetative Growth and Chemical Composition of Dill Plants (*Anethum graveolens*, L)

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ABSTRACT: *Anethum graveolens* (Dill) is one of the most important pharmaceutical plants of Fam. Apiaceous on most addition, fertilization is one of the productivity of the given plant their fine, Two field experiments were conducted at the experimental farm of the Faculty of Agriculture (Saba-Basha), Alexandria University during both seasons, 2013/2014 and 2014/2015 to study the effect of vegetative growth, chemical composition of dill (*A. graveolens*). The applied experiment design was randomize complete blocks design with three replicates. The main results stated that (1) the fertilization treatments differently, affected the mean values of all studied characters, and differently affected the mean value of all studied characters.(2) the application of $5m^3$of organic manure + A-Mycorrhizal, significantly resulted in increased plant height, fresh and dry weight as well as chlorophyll a and b contents, chemical composition of (N,P and K%) and Vitamin C content, as well as essential oil percentage. The conclusion from the present investigation revealed that the application of $5m^3$ organic manure + bio- fertilization (Mycorrhizal) led to the highest growth characters and chemical composition of dill plants.
Keywords: Organic fertilizer, biofertilizer, vegetative growth, chemical composition

INTRODUCTION

Anethum graveolens L. (Dill) fam: Apiaceaeis one of the important pharmaceutical plants the part used of dill is the herb produced from the whole over ground part of the plant, the seeds. Flowering top, or leaves combine well with a variety of foods. Dill seed oil is used as a flavoring agent by food industries before the introduction of the now much more popular dill herb oil (Rashed, 2002).

Fertilization is one of the most important factors- limiting- the productivity of plants, the intensive use of expensive mineral fertilizers, in-recent years; results in environmental pollution problems. However, chemical fertilizers, at extremely high rates for a long period, decreased the potential activity of microflora and the stability of soil organic matter (Hussein, 1995). Additionally, organic manures are in the form of compost or animals manures.

Farmyard manure (FYM) and green manure (organic materials) are generally added to soils to improve their physical and chemical properties. They enhance the soil fertility by their composition of macro- and microelements, amino and organic acids, sugars and organic matter (Hammam, 1996). Furthermore bio-fertilization is an important factor being used to produce products without some mineral fertilizer that cause environmental pollution problems, and high rates of it; lead to decrease the potential activity of microflora and the mobility of organic matters. Hence, the inoculation of dill seeds with A-Mycomhizal was found to be capable of fulfilling the requirements of N content in the plant and induce pronounced increases in plant growth and

biological yield of dill and other crops (Harridy and Amara, 1998; Gad, 2001;Rashed, 2002 and Mohamed and Abdou, (2004)

This research, however, is an attempt to find out the best fertilization treatments (organic, bio- and chemical fertilization) on vegetative growth and chemical composition of dill plants (*Anethum graveolens*, L.).

MATERIALS AND METHODS

Two field experiments were carried out at the Experimental farm of the Faculty of Agriculture (Saba- Basha), Alexandria University, at Abees region, Alexandria, Egypt, during both growing seasons of 2013/2014 and 2014/2015 to study the effect of organic, bio and chemical fertilization on vegetative growth and chemical composition of *Anethum gravelens*, L. (dill) Plants. The experimental design was randomized complete block design with three replicates. The dill seeds were sown on November 10^{th} and 15^{th}during both growing seasons. The plots area of each was 4 square meters (2.0 x2.0m^2) with 3 rows; the distance between the rows was 50cm and 10cm between plants.

The chemical fertilizers as ammonium sulphate (20.5%,N), calcium superphosphate (15.5,% P_2O_5) and potassium Sulphate were applied (48% K_2O) at the rates of (100, 100 and 50kg/fed, respectively), which are the recommended dose. The used bio-fertilization of seed treatment with A-Mycomhial spores, A-Mycorrhizal inoculation was prepared and added as described by Radwan (1996). local strain of *Glomus macrocarpum* was obtained from Plant Production, Dept. Fac. of Agric. (Saba-Basha), Alexandria Univ., Alex., Egypt. The organic fertilization (Sheep manure) was applied at the three rates of 5,10 and 15m^3/fed, which were applied through the soil preparation before sowing. The recommended doses of NPK were divided in two equal parts, the first one was applied one month after sowing and the second one was applied after both irrigations.

The tested treatments were conducted as follows:-

T1 : NPK-control (100: 100: 50 kg/fed, respectively)

T2 : 5m^3 organic manure/fed

T3 : 10m^3 organic manure/fed

T4 : 15m^3 organic manure/fed

T5 : Mycorrhizae

T6 : 5m^3 organic + Mycomhizae

T7 : 10 m^3 organic + Mycomhizae

T8 : 15 m^3 organic + Mycomhizae

T9 : ½ NPK + Mycomhizae

T10 : ½ NPK + Mycomhizae + 10m^3 organic manure

The physical and chemical characteristics of the experimental soil, and the used sheep manure compositions are given Tables (1 and 2). The soil was analyzed according to be methods described by Page*etal.* (1982).

Table (1).The physical and chemical properties of the experimental soil in 2014/2015 and 2015/2016 seasons.

Soil properties	Value	
	2013/2014	2014/2015
Particle size distribution (%)		
Sand	**15.70**	**14.90**
Silt	**41.30**	**42.10**
Clay	**43.00**	**43.00**
Soil Mixture	**Clayloam**	**Clay loam**
Chemical properties		
pH (1 : 1)	**7.80**	**7.90**
EC (1 : 1),dS/m	**2.30**	**2.20**
Soluble cations (1 : 1) (Cmol/Kg soil)		
K^+	**1.00**	**0.98**
Ca^{2+}	**4.25**	**4.30**
Mg^{2+}	**3.30**	**3.20**
Na^+	**8.30**	**8.20**
Soluble anions (1 : 1) (Cmol/kg soil)		
$CO^{=}_3 + HCO^{-}_3$	**2.80**	**2.70**
CL^-	**11.50**	**11.70**
$SO^{=}_4$	**0.50**	**0.49**
Calcium carbonates(%)	**7.70**	**7.80**
Organic matter (%)	**1.00**	**0.90**
Total Nitrogen (%)	**0.49**	**0.50**
Available phosphorus (mg/kg)	**3.90**	**4.10**
Available K (mg/kg)	**162.30**	**171.10**

Also, the chemical analysis of the organic manure was carried out according the method of Jackson (1967).

Table (2). Analysis of the applied organic manure (sheep manure).

pH	**7.50**
Organic matters (OM,%)	**31.72**
Organic carbon(OC,%)	**18.40**
Total N (%)	**2.30**
Total P (%)	**1.20**
Total K (%)	**1.50**
C : N ratio	**8 : 1**

At harvest dates of February 8 and 10 during both seasons, guarded plants were, randomly, taken from each plots and the following characteristics were recorded:

1- Plant height (cm)
2- Fresh and dry weights of aerial parts /plant
3- Chlorophyll (a) and (b) mg/g fresh weight were determined in fresh herbs samples of the fifth leaf from top at harvest and after 3 days for dill using the method described by Moran (1982).
4- The essential oil percentage was determined in the dried herb according to British pharmacopoeia (1963).
5- Phosphorus was determined colorimetrically using the method described by Jackson (1967) and potassium was estimated using flame photometer method according to Richards (1954).
6- Vitamin (C) content was determined in filtered juice samples and expressed as a ascorbic mg acid /100 ml/fresh juice as described by A.O.A.C. (1965)
7- The N,P and K contents were determined in the acid digested solution which was prepared according to Hack *et al*., (1985) using mixture of hydrogen peroxide and sulfuric acid (4 : 10).
8- Element extraction with made on a known weight of dried samples (0.2 mg).

The obtained data, statistically, analyzed using ANOVA and L. S.D. values were calculated to test the differences between means of the studied treatments according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

I. Vegetative growth

The obtained results presented in table (3) cleared that fertilizer treatments exhibited a significant effect on all estimated traits during both seasons. Application of T6 treatment (5m^3 height organic manure /fed + A-Mycomhizal) significantly, increased plant height (cm), fresh weight (g), dry weight (g) in both seasons. It could be concluded that this positive effect on growth characters in response to sheep manure levels, may be attributed to

increasing *meant ration* in plant tissues (Opera and Sigebu, 1996). Also, Inoculation A-mycomhizal may increase the synthesis of endogenous phytohormones, i.e. IAA, GAs and CKs which play an important role in formation of a big active root system which allow more nutrients uptake. The previous results agree, more or less, with the findings of Gad (2001) *on Anethum gravolens*, Abdel –latif (2002) on *Caruimcarvi*, Kandeel *et al.,* (2001) and Mohamed and Abdu (2004) on *Foeniculum vulgar*e.

II. Chlorophyll and Vitamin C Contents

Data in Table (4) showed that the treatment (T6) application $5m^3$Organic manure + brofertilizer (Mycomhizal) resulted in the highest Chlorophyll a, b and Vitamin C content, as compared to the other treatments in both seasons. The least Chlorophyll a, b and Vitamin C contents was obtained with application of 1/2 NPK +Mycomhizal + $10m^3$ (26 and 27mg/g fresh weight) in chlorophyll a, (11.72 and 11.90 mg/g fresh weight)in chlorophyll b and (65.58 and 66.10mg/100ml juice) for Vitamin C content in both season, respectively.

The increase in chlorophyll (a) by using $5m^3$ Organic manure and Mycomhizal (biofertilizer) may be due to Mg element from organic fertilizer, also microbiological processer can change unavailable forms of nutrients into available ones in absence of chemical fertilization (Subb Rao, 1982) Also, the addition of $5m^3$ organic manure + Mycomhizal to the soil increased Vitamin (C) content in the plant juice. This may be due to the increment of biological. Which processes which help in solubilization of mineral nutrient Synthesis of Vitamins, amino aceds auxins and gibberellins, which stimulate growth as well as the Vitamins contents of juice (Sprenat, 1990). These results are similar to those of Hammam (1996) and Gomaa and Abo Aly (2001) in anise plants.

III. Chemical composition and essential Oil

The data in Table (5) showed that all treatments of fertilization affected chemical composition (N, P and K%) and oil essential (%) content in both seasons. It is clear from the obtained data, that the highest mean values of chemical composition (N, P and K%) and oil essential (%). content, resulted from the treatments of (T6) [$5m^3$] organic manure /fed + A-Mycouhizal in both seasons.

The increment of chemical composition (N,P and K%), and essential oil (%) of plants, herb using the treatment of organic manure + (biofertilizer) A-Microbial may be attributed to increase in the occupancy root zone of plant as a results of adding fertilization treatments which reflected on nutrient uptake by plants and confirm the previous of vegetative growth. Similar results, more or less were obtained by Kandeel *et al*. (2001) and Abou El-Maged*et al.* (2008) on fennel Rashed (2002) on *Anethum gravolens*. Likewise, the results showed significant differences for organic manure +Biofetilizer in the both seasons, which gave the greatest values for all chemical composition. We could concluded from this study that using a combination of $5m^3$ organic manure with bio-fertilizer (Mycorrhizal) has led to obtain the highest mean values of the vegetative growth, chemical composition in addition dill oil percentage.

Table (3).Effect of fertilization treatments on vegetative growth during 2013/2014 and 2014/2015 seasons.

Treatments	Chlorophyll (a) (mg/g)		Chlorophyll (b) (mg/g)		Vitamin (c) mg/100 ml Juice	
	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015
T1 : NPK-control	26c	28d	15.45e	13.31d	78.00d	76.70de
T2 : 5m^3 organic manure/fed	27d	26f	16.48d	15.70e	82.39d	80.40d
T3 : 10m^3 organic manure/fed	28c	26f	19.00b	18.50ab	95.02b	93.20b
T4 : 15m^3 organic manure/fed	26e	30b	17.67c	17.50b	88.34c	86.80c
T5 : biofertilizar (Mycouhizal)	28c	27e	18.03b	17.50b	80.13d	79.90d
T6 : 5m^3 Organic + Mycomhizal	34a	32a	20.50a	19.20a	104.94a	102.60a
T7 : 10 m^3 organic + Mycomhizal	28c	29c	12.93f	12.70de	65.66	66.70f
T8 : 15 m^3 organic + Mycomhizal	26e	27e	13.00f	12.90de	7.00e	73.10e
T9 : ½ NPK + Mycomhizal	31.0b	30b	12.77fg	12.66de	62.67f	65.80f
T10 : ½ NPK + Mycomhizal + 10m^3 Organic/fed	26e	27e	11.72g	11.90e	65.58e	66.40f
L.S.D.(0.05)	0.30	0.28	1.05	1.03	5.70	5.40

Means followed by the same letters (s) is (are) not significantly different at 0.0.5 levels of probability.

Table (4). Effect of fertilization treatments on vegetative growth during 2013/2014 and 2014/2015 seasons.

Treatments	Chlorophyll (a) (mg/g)		Chlorophyll (b) (mg/g)		Vitamin (c) mg/100 ml Juice	
	2013/2014	2014/2015	2013/2014	2014/2015	2013/2014	2014/2015
T1 : NPK-control	1.48d	1.38d	0.40d	0.35d	38.70e	40.10g
T2 : 5m^3 organic manure/fed	1.50cd	1.42cd	0.42d	0.36d	42.60d	43.70f
T3 : 10m^3 organic manure/fed	1.52b	1.47c	0.41d	0.35d	43.30d	44.50e
T4 : 15m^3 organic manure/fed	1.59b	1.97c	0.45b	0.46b	44.80c	44.90e
T5 : biofertilizar Mycorrhizal	1.60a	1.53b	0.46bc	0.45dc	45.40b	47.20c
T6 : 5m^3 organic + Mycomhizal	1.77b	1.62a	0.50a	0.51a	48.50a	50.40a
T7 : 10 m^3 organic + Mycomhizal	1.65ab	1.54b	0.46b	0.46b	46.70b	48.10b
T8 : 15 m^3 organic + Mycomhizal	1.67b	1.58ab	0.49a	0.49a	45.50b	47.20c
T9 : ½ NPK + Mycomhizal	1.66b	1.54b	0.45bc	0.45bc	46.40b	46.70e
T10 : ½ NPK + Mycomhizal + 10m^3 Organic/fed	1.64b	1.53b	0.42c	0.42c	46.30b	45.30e
L.S.D.(0.05)	0.10	0.05	0.03	0.03	1.05	1.10

Means followed by the same letters (s) is (are) not significantly different at 0.0.5 levels of probability.

Table (5).Effect of fertilization treatments on chemical composition and essential oil percentages during 2014 and 2015 seasons.

Treatments	N %		P %		K %		essential Oil content	
	2014	2015	2014	2015	2014	2015	2013/2014	2013/2014
T1 : NPK-control	3.06e	3.22e	0.75h	0.81f	2.01i	2.25h	0.159	0.18g
T2 : 5m^3 organic manure/fed	3.20de	3.37e	0.90g	0.95e	2.30h	2.45g	0.20e	0.24e
T3 : 10m^3 organic manure/fed	3.33de	3.50d	0.96e	0.98d	2.55g	2.60f	0.20e	0.25d
T4 : 15m^3 organic manure/fed	3.50c	3.77bc	0.98d	1.02c	2.75e	2.83e	0.18f	0.22f
T5 : Mycorrhizal	3.70bc	3.85b	1.05c	1.10b	2.88c	2.91d	0.25c	0.28c
T6 : 5m^3 organic + Mycomhizal	4.17a	4.25a	1.20a	1.18a	3.30a	3.35a	0.32a	0.35a
T7 : 10 m^3 organic + Mycomhizal	3.90b	3.85b	1.10b	1.09b	3.05b	3.17b	0.26b	0.29b
T8 : 15 m^3 organic + Mycomhizal	3.80b	3.81b	0.95e	0.98d	2.90c	3.01c	0.20e	0.25d
T9 : ½ NPK + Mycomhizal	3.55c	3.60cd	0.93f	0.96e	2.60f	2.90d	0.22d	0.24e
T10 : ½ NPK + Mycomhizal + 10m^3 Organic/fed	3.50c	3.5d	0.96e	0.97d	2.80d	2.90d	0.22d	0.24e
L.S.D.0.05	0.25	0.22	0.012	0.01	2.02	0.03	0.003	0.004

Means followed by the same letters (s) is (are) not significantlyy different at 0.0.5 levels of probability.

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الملخص العربى

تأثير الأسمدة العضوية والحيوية والكيميائيةعلي صفات النمو والمكونات الكيماوية لنباتات الشبت

*** فتحى ابراهيم رضوان *على ابراهيم على عبيدو**السيد محمد المحروق**
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أجريت تجربتان حقليتان خلال موسمى الزراعة ٢٠١٣/٢٠١٤ – ٢٠١٤/٢٠١٥ لدراسة تأثير التسميد العضوى والحيوى والكيماوى على صفات النمو الخضرى والمحتوى الكيماوى لنبات الشبت وقد استخدم فى هذه التجارب التصميم الإحصائى للقطاعات العشوائية الكاملة لثلاث مكررات ويمكن تلخيص النتائج فيما يلى :
١- إدى استخدام معاملات التسميد لتأثيرات معنوية مختلفة على أعلى متوسط لقيم جميع الصفات الدراسية
٢- أدى إضافة ٥م٣ سماد عضوى + ميكوريزا إلى زيادة معنوية لإرتفاع النبات والوزن الطازج والجاف للنبات كلوروفيل أ، ب والمكونات الكيماوية (نتروجين) فوسفور بوتاسيوم %) ومحتوى فيتامين س فى كلا الموسمين .
٣- نوصى بإستخدام ٥ طن سمادعضوى + ميكوريزا للحصول على أفضل نمو وجودة لنبات الشبت.