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EFFECT OF COMPOST FERTILIZATION LEVELS ON GROWTH, YIELD AND CHEMICAL COMPOSITION OF SANDY SOIL GROWN *AMMI VISNAGA* PLANTS

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ABSTRACT: The present investigation was conducted at the nursery of Fac. of Agric., Minia Univ. during the two successive seasons of 2014/2015 and 2015/2016 to explore the most suitable level of compost for *Ammi visnaga* plants grown in sandy soil.

All studied vegetative growth characters (plant height, branch number and herb dry weight/plant); yield parameters (number of umbels/plant and seed yield per plant and per fed); and chemical constituents (photosynthetic pigments and herb percent and content of N, P and K) were gradually increased parallel to the increase in compost level added to the soil. However, no clear difference was obtained, for all prementioned traits, between the medium compost level (12.5 ton/fed) and the high one (17.5 ton/ fed). In general, seed yield per fed, due to medium or high compost rate was increased by about 30%.

Key words: *Ammi visnaga*, compost, sandy soil and vegetative growth characters.

INTRODUCTION

One of the common aromatic and medicinal plants grown successfully in the middle Egypt Governorates is Khella (*Ammi visnaga*, L.) plant. It belongs to Fam. Apiaceae and native to the Mediterranean region, from where it spread out to Western Asia, North and South America and Europe. It is a winter annual herb, which known as an important pharmaceutical plant. The seeds are diuretic, carmatative, stimulant, antispasmatic and used to treat congestion of prostate gland, urinary diseases and renal stones, asthma remedy and respiratory problems. The dry umbel rays are used as toothpicks. The most important active ingredients are khellin and visnagin. This experiment aimed to explore the possibility of growing khella plants in sandy soil with the aid of compost fertilization under the environmental conditions prevailed in Minia Governorate.

Many researchers investigated the positive influence of compost and other organic fertilizers in augmenting vegetative growth characters, and yield parameters of different aromatic seed crops such as Younis *et al.* (2004) on Khella; Badran *et al*. (2007), Ahmadian *et al.* (2011), Asl and Moosavi (2012) and Seghatoleslami (2013) on cumin; Tanious (2008), Azzaz *et al.* (2009), Mahmoudi and Asgharipoor (2014) and Badran *et al.* (2017a) on fennel; Hemdan (2008) on anise and Shoor *et al.* (2010) on *Nigella sativa*. While other authors insured the capability of organic fertilization in promoting various chemical constituents of fennel (Fernandez *et al.*, 2002; Tanious, 2008; Badran *et al.*, 2017a and Badran *et al.*, 2017b); Khella (Younis *et al.*, 2004 and Kenawy, 2010); coriander (Abd-Elgawad, 2007); anise (Hemdan, 2008 and Ali *et al.*, 2010); *Nigella sativa* (Mahmoud, 2009) and dill (Hassan *et al.*, 2010).

MATERIALS AND METHODS

This experiment was carried out during the two seasons of 2014/2015 and 2015/2016 in the Nursery of Fac. of Agric., Minia Univ. to study the influence of four compost fertilization levels on vegetative growth, yield, chemical constituents of *Ammi visnaga*, L. plants grown in sandy soil.

Four to six seeds were sown, on Oct., 20th for both seasons in square tin containers filled with 20 kg washed sand with physical and chemical properties shown in Table (a). Before seed sowing, the used sand for each container was mixed thouroughly with compost El-Neel, Table (b) obtained from the Egyptian Co., for solid waste. Utilization, New Minia City at different levels according to the assigned treatments.

Table a. Physical and chemical properties of the used sandy soil.

Soil property	1st season	2nd season
Particle size distribution		
Sand (%)	81.70	82.30
Silt (%)	11.80	11.60
Clay (%)	6.50	6.10
Texture	Sandy	Sandy
Organic Matter (%)	0.30	0.28
$CaCO_3$ (%)	14.30	14.40
pH (1:2.5 soil suspension)	7.80	7.85
CEC (mg/100 g soil)	8.20	8.24
Exh. cation (mg/100 g soil)		
Ca	3.80	3.84
Mg	1.60	1.56
Na	2.00	2.04
K	0.60	0.64
Available N (%)	0.06	0.06
Available P (%)	3.50	3.45
DTPA extraction (ppm)		
Fe	1.10	1.20
Mn	0.60	0.61
Zn	0.30	0.33

Table b. Chemical analysis of the compost.

Content	Value	Content	Value
Organic carbon (%)	23.5	**Total P (%)**	0.60
Humidity (%)	22.5	**Total K (%)**	0.92
Org. matter (%)	41.0	**Fe (ppm)**	170.0
C/N ratio	18.0	**Zn (ppm)**	80.0
pH (1: 2.5)	7.5	**Mn (ppm)**	105.0
EC (mmhos/cm)	4.0	**Cu (ppm)**	210.0
Total N (%)	1.3		

Three weeks from sowing date, the seedlings per each container were thinned to 4 plants and 2 weeks later thinning was done by leaving two plants per container.

The layout of the experiment was complete randomized block design with three replicates and five container, replicate. The four compost levels were 0, 7.5, 12.5 and 17.5 ton/fed and were mixed with sand, for each container, according to each treatment, before seed sowing. All other agricultural practices were performed as usual.

Data were recorded, at the end of each season for plant height (cm), branch number/plant, herb dry weight/plant (g), number of umbels/ plant, fruit yield per plant (g) and per fed (kg), chemical constituents were determined for chlorophyll a, chlorophyll b and carotenoids contents according to Fadl and Seri-Eldeen (1978), and for nitrogen, phosphorus and potassium % in the herb according to Wilde *et al.* (1985), Chapman and Pratt (1975) and Cottenei *et al.* (1982), respectively. Obtained data were statistically analyzed following the LSD method by the use of MSTAT-C (1986).

RESULTS

Vegetative growth characters:

Data in Table (1) show that the three compost levels namely, 7.5, 12.5 and 17.5 ton/fed caused significant increase in the three studied vegetative growth traits of *Ammi visnaga* plants (plant height, branch number/plant and herb dry weight/plant), in both seasons, in comparison with those of control treatment.

Table 1. Effect of compost fertilization levels on vegetative growth characters of *Ammi visnaga* plants during the two seasons of 2014/2015 and 2015/2016.

Compost treatments (ton/fed)	Plant height (cm)		Branch No./plant		Herb D.W. (g/plant)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control 0	74.1	93.2	3.26	3.81	37.5	42.2
7.5	84.2	101.5	3.50	4.68	45.8	53.9
12.5	86.3	106.6	3.99	5.08	49.2	58.7
17.5	90.0	108.2	4.14	5.24	51.8	61.1
L.S.D. 5%	5.2	7.8	0.21	0.37	3.5	5

Such increase, for all growth characters was gradual and parallel to the gradual increase in the applied compost level where the highest values were due to the high compost level (17.5 ton/fed). However no significant differences were detected, for the three characters in both seasons, between the high and medium compost levels as clearly shown in Table (1).

Numerically, the increase in plant height, branch number and herb dry weight/plant, respectively, due to the low, medium and high compost levels, in comparison with control treatment, reached 13.6, 16.5 and 21.5% for plant height, 7.4, 22.4 and 27.0% for branch number and 22.1, 31.2 and 38.1% for herb dry weight in the first season. The corresponding increases due to the three compost levels, respectively, in the second season came to 8.9, 14.4 and 16.1% for plant height, 22.8, 33.3 and 37.5% for branch number and 27.7, 39.1 and 44.8% for herb dry weight. In agreement with these results were the findings of Younis *et al.* (2004) on khella; Badran *et al.* (2007) and Asl and Moosavi (2012) on cumin and Tanious (2008), Azzaz *et al.* (2009) and Badran *et al.* (2017a) on fennel.

Yield and yield component parameters:

The three yield parameters, number of umbels/plant and fruit yield per plant and per fed were greatly and significantly augmented in the two seasons as a result of using compost at the three levels (7.5 , 12.5 and 17.5 ton/fed) in comparison with those of unfertilized control plants as illustrated in Table (2). The increase in such three yield parameters was moving upward by the gradual increase in compost fertilization level, with no significant differences being obtained between the medium (12.5 ton/fed) and the high (175 ton/fed) compost levels. The fruit yield/fed due to the medium and high compost fertilization levels recorded 429 and 443 kg respectively, in the first season and 483 and 502 kg, respectively in the second season, (Table 2). Therefore, the reduction in the yield/fed due to the use of the medium compost level instead of the high one registered only 3.16% in the first season and 3.78% in the second season as shown in Table (2). The role of enhancing the yield of aromatic seed plants was shown on cumin (Badran *et al.*, 2007; Ahmadian *et al.*, 2011 and Seghatoleslami, 2013); *Nigella sativa* (Shoor *et al.*, 2010) and fennel (Mahmoudi and Asgharipoor, 2014 and Badran *et al.*, 2017a).

Photosynthetic pigments:

Table (3) shows clearly that the three photosynthetic pigments were significantly promoted due to all three compost levels, except that of chlorophyll b in the second season, in comparison with control plants. Such promotion was gradual and parallel with the gradual increase in compost level with the highest values being obtained due to the high compost level (17.5 ton/fed). However, no significant differences were detected between the medium and the high compost levels for the three photosynthetic pigments in both seasons as clearly shown in Table (3). Different authors stated the role of organic fertilizers in promoting chlorophyll a, chlorophyll b and carotenoids contents in various aromatic seed plants such as Abd-Elgawad (2007) on coriander; Tanious (2008) and Badran *et al.* (2017a) on fennel.

Table 2. Effect of compost fertilization levels on yield components of *Ammi visnaga* plants during the two seasons of 2014/2015 and 2015/2016.

Compost treatments (ton/fed)	Umbels No./plant		Seed yield/plant (g)		Seed yield/fed (kg)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control 0	7.1	8.0	5.10	5.81	328	371
7.5	9.8	11.6	6.33	7.17	405	460
12.5	11.4	12.9	6.70	7.56	429	483
17.5	11.8	13.3	6.94	7.88	443	502
L.S.D. 5%	1.1	0.8	0.56	0.83	37	46

Table 3. Effect of compost fertilization levels on the three photosynthetic pigments (mg/g F.W.) of *Ammi visnaga* plants during the two seasons of 2014/2015 and 2015/2016.

Compost treatments (ton/fed)	Chlorophyll a		Chlorophyll b		Carotenoids	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control 0	1.54	1.79	1.12	1.15	1.18	1.27
7.5	1.73	1.92	1.16	1.18	1.31	1.40
12.5	1.86	2.01	1.18	1.19	1.34	1.45
17.5	1.91	2.07	1.19	1.20	1.37	1.50
L.S.D. 5%	0.06	0.08	0.04	0.05	0.07	0.06

Hemdan (2008) on anise, Mahmoud (2009) on *Nigella sativa* and Kenawy (2010) on khella.

Nitrogen, phosphorus and potassium percentage in the herb:

Obtained results in Table (4) show that the herb % of N, P and K were greatly and significantly increased, in the two seasons, as a result of supplying *Ammi visnaga* plants with compost at any used level compared to control plants.

Such increase in the three nutrients % was parallel to the gradual increase in the applied compost level. Therefore, the highest values were obtained from the high compost level (17.5 ton/fed) and the least values were obtained from the low compost level (7.5 ton/fed), while the intermediate value were those given by the medium compost level (12.5 ton/fed) as shown in Table (4).

On the line with these results were those revealed by Abd- Elgawad (2007) on coriander; Tanious (2008) and Badran *et al.* (2017a) on fennel; Mahmoud (2009) on *Nigella sativa*; Hassan *et al.* (2010) on dill and Kenawy (2010) on *Ammi visnaga*.

Nitrogen, phosphorus and potassium contents in the herb:

The herb contents of N, P and K as influenced by compost fertilization treatments, followed the same trend like that of N, P and K%. Each one of the three compost levels resulted in significant increase in the contents of the three tested nutrients in the two seasons in comparison with control treatment as clearly illustrated in Table (5). However, among the three compost levels, the highest N, P and K content values were given by the high compost level (17.5 ton/fed), followed by the medium level (12.5 ton/fed), These two compost level treatments increased herb nitrogen and potassium contents by more than 50% and herb phosphorus content by more than 45% in comparison with those of control treatment in both first and second seasons, (Table 5). This role of increasing N, P and K contents by organic fertilization was reported by Fernandez *et al.* (2002) and Badran *et al.* (2017b) on fennel; Younis *et al.* (2004) on khella; Abd-Elgawad (2007) on coriander. Hassan *et al.* (2010) on dill and Ali *et al.* (2010) on anise.

Table 4. Effect of compost fertilization levels on N, P and K% in the herb of *Ammi visnaga* plants during the two seasons of 2014/2015 and 2015/2016.

Compost treatments (ton/fed)	Herb N %		Herb P %		Herb K %	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control 0	0.91	1.11	0.241	0.252	1.17	1.38
7.5	0.97	1.25	0.254	0.264	1.43	1.51
12.5	1.07	1.30	0.270	0.268	1.48	1.56
17.5	1.11	1.36	0.274	0.271	1.52	1.62
L.S.D. 5%	0.05	0.06	0.011	0.008	0.07	0.09

Table 5. Effect of compost fertilization levels on N, P, and K contents (mg/plant) of *Ammi visnaga* plants during the two seasons of 2014/2015 and 2015/2016.

Compost treatments (ton/fed)	Herb N content		Herb P content		Herb K content	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control 0	340	470	90	107	440	583
7.5	445	674	108	143	657	814
12.5	525	764	133	158	726	915
17.5	576	833	142	166	787	988
L.S.D. 5%	54	68	12	18	50	71

DISCUSSION

The beneficial roles of organic fertilization, in sort of compost in this trial, in enhancing vegetative growth, yield and chemical constituents of *Ammi visnaga* plants grown in sandy soil could be attributed to its capability in increasing total nitrogen, organic matter and humus in the soil, improving soil properties and water holding capacity particularly when added to sandy soil, making most micronutrients more readily available at a wide range of pH and accelerating the release of essential nutrients by microbial decomposition, (Follet *et al.*, 1981).

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تأثير التسميد بمعدلات مختلفة من الكمبوست على النمو والمحصول والتركيب الكيماوى لنباتات الخلة البلدى المزروعة بالاراضى الرملية

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تم إجراء هذه التجربة بمشتل كلية الزراعة- جامعة المنيا خلال موسمين متتابعين ٢٠١٥/٢٠١٤ و ٢٠١٦/٢٠١٥ بهدف التوصل لانسب معدل من التسميد بالكمبوست لنباتات الخلة البلدى المزروعة بالاراضى الرملية.

حدثت زيادة تدريجية بالتوازى من زيادة معدل التسميد بالكمبوست المضاف للتربة الرملية وذلك لكل من الصفات الخضرية (طول النبات، عدد الفروع، الوزن الجاف للعشب) والمحصولية (عدد النورات للنبات، محصول البذور للنبات وللفدان) والمكونات الكيماوية (الصبغات الضوئية الثلاثة والنسبة المئوية ومحتوى العشب من كل من النتروجين والفوسفور والبوتاسيوم)، ولقد اتضح عدم وجود فروق واضحة لكل الصفات السابق ذكرها نتيجة المعاملة بالمعدل المتوسط (١٢,٥ طن للفدان) أو المعدل المرتفع (١٧,٥ طن للفدان) وعموما فقد وصلت الزيادة نتيجة التسميد بالكمبوست باى من المعدل المتوسط أو المعدل المرتفع فى محصول البذور للفدان الى حد ٣٠%.