

## **Effect of Fertilization and Plant Density on Seed and Oil Productions of *Nigella sativa*, L.**

**EL-Kadi, B.M. and G.T. Mousa , M.M .Gad , E.F. Ali**

Ornamental Plants Department, Faculty of Agriculture, Assiut University

---

### **Abstract:**

A field experiment was carried out in the Experimental Farm of Assiut University during 2010-2011 and 2011- 2012 seasons. The study aimed to obtain the best yield of *Nigella sativa* L. seeds and volatile oil per experimental unit (1 × 1.5 m ) by using three plant densities ; low ( 20-plant/ plot) , medium(40-plant / plot) and high ( 80-plant / plot ) and four fertilizer treatments; control (without fertilization) , mineral fertilizer (NPK 70kg/fed.) , cattle manure (CM 30 m<sup>3</sup>/fed.) and foliar fertilization TOP STAR (NPK+TE 2g/l).

The results showed that low plant density increased both of seed yield and volatile oil production per plant followed with medium and high plant density with significant differences in most cases.

Using of mineral fertilizer (NPK) considerably increased both of seed yield and volatile oil per

Plant compared with unfertilized plants (control). Although same increases resulted with cattle manure and foliar fertilizer the differences were not always significant. During the first and second seasons

As yield per feddan, results showed that both of high plant density and mineral NPK fertilizer resulted in considerable higher production in both of seed and volatile oil yields compared with the other treatments.

The interaction among plant densities and the different fertilizer treatments showed that the highest yield of both seeds and volatile oil per feddan, generally, resulted with the high plant density accompanied with mineral NPK fertilization.

## Introduction:

Black cumin (*Nigella sativa*, L.) is one of the most important medicinal plants, cultivated for seed production and oil yield in many countries. Concerning the effect of plant density treatments, Sedigheh *et al* (2009) tested the effect of plant density; 50, 100, 150 and 200 plant /m<sup>2</sup> on *Ocimum basilicum* L. . Results indicated that 200 plant / m<sup>2</sup> gave the highest seed yields. Tuncturk *et al* (2005) pointed out the response of black cumin to different seed rates; 5 , 10 , 15 and 20 kg / ha . Data showed that the highest seed yield and essential oil yield were obtained from the 15kg/ha. Akhani *et al* (2012) studied the effect of plant density in three levels (12.5 , 16.6 and 25 plants/m<sup>2</sup>) on *Coriandrum sativum* . Results showed that the highest seed yield was obtained with 25 plants/ m<sup>2</sup> .

Some investigators studied the effect of different fertilizer treatments on seed and oil production of some umbelliferous plants. Ayub *et al* (2011) applied different levels of nitrogen; 0, 30, 45, 60, 75, 90, 105 and 120 kg /ha on fennel . The treatment of 90 kg /ha produced higher seed yield compared with all treatments. Tuncturk *et al* (2012) evaluated the effect of varying nitrogen doses of ammonium sulphate (21 % N) ; 0 , 20 , 40 , 60 and 80 kg /ha on the yield and some yield components of black cumin . The results showed that the highest values were obtained in seed yield (575kg ha) from 60kg N /ha application. Tuncturk *et al* (2011) on black seed concluded that the highest seed yield were obtained from 40 kg P /ha fertilizer application. Shah (2007) used the N fertilization of black cumin. The results showed that 80 kg N /ha enhanced seed yield /ha.

Ehsanipoura *et al* (2012) tested the effect of nitrogen rates; 0, 40, 80, 120 and 160 kg N /ha on fennel, The results showed that 160 kg /ha N fertilizer increased seed yield and seed essential oil yield. Menari *et al* (2007) found that 90 kg N+ 40 kg P<sub>2</sub>O<sub>5</sub>+20 Kg K<sub>2</sub>O +20 kg S+5 kg Zn/ha gave highest seed yield of fennel. Mollafilabi *et al* (2010)) found that the highest seed and essential oil yield of black cumin were obtained at treatment of 50 kg N /ha . Valadabdi *et al* (2011) studied the effect of organic fertilization ; 0 , 10 , 20 and 30 ton / ha on black cumin. The results showed that 20 ton / ha increased essential oil yield compared with 10 and 30 ton\ha. On *Pimpinella anisum*. Darzi (2012) applied three levels of organic fertilizers; 0, 5, 10 ton /ha. Results showed that the highest seed yield, and essential oil yield were obtained after applying 10 ton/ha .

## Material and Methods:

Field experiments were carried out during 2010-2011 and 2011-2012 at the Floriculture Nursery Experimental Farm, Assiut University. The aim of study was to clear the effect of mineral NPK, cattle manure and foliar fertilization under three plant densities on seed yield and volatile oil production of *Nigella sativa*, L. seeds.

Complete randomized block design in a split plot arrangement with 4 replicates was used. Plant densities were randomly distributed in main plots and the fertilizer treatments in the sub plots. The experimental units each was 1× 1.5 meter. Seed were sown on 5<sup>th</sup> November during the two growing seasons. Soil texture was clay loam (pH7.6). Plants were harvested in the mature stage at April

22<sup>nd</sup> and 15<sup>th</sup> for the first and second seasons, respectively. Plant density treatments were ; low (20plant / plot) , medium (40 plant / plot) and high (80 plant / plot) Fertilization treatments were; Control(without fertilizer) , NPK 70 kg/ fed (30kg NH<sub>4</sub>NO<sub>3</sub> + 30kg P<sub>2</sub>O<sub>5</sub> + 10kgK<sub>2</sub>O/), cattle manure (CM 30m<sup>3</sup>/ fed) , and Foliar fertilization; (TOP STAR NPK 20-20-20) 2g/l .

Data were recorded at the time of fruit ripening. Volatile oil was determined in dried and crushed seeds as described by Anonymous (1961).

### **Results and Discussion:**

The obtained results cleared that plant density showed a significant increase in seed yield during both seasons (Table,1). Seed yield (g/plant) was increased by decreasing plant density from the high to the low one. The low plant density treatment resulted in considerable significant increase in seed yield reached 25% and 15 % followed with medium treatment compared with high one during the first and second seasons,

Respectively. Some authors reported that low plant density treatment increase seed yield; Azizi *et al* (2008) on *Cuminum cyminum L.* found that low plant density gave the highest seed yield per plant and Nakaei *et al* (2012) on *Foeniculum vul-*

*gare L* attributed increasing seed yield to the increase of plant density from 10 to 20 plant per m<sup>2</sup>

As yield per feddan, results showed that high plant density significantly increased seed yield per feddan compared with both of medium and low one during the two growing seasons. Some investigators such as Sedigheh *et al* (2009) on *Ocimum basilicum L.* and Zareie *et al* (2012) On *Coriandrum sativum L.*, found that high plant density increased seed yield per feddan.

Concerning fertilizer treatments, results showed a significant increase in plant seed yield with NPK fertilization treatments compared to control during two seasons (Table,1 and Fig.1). The mineral NPK treatment increased plant seed yield by 54% & 33% over control in the first and second seasons, respectively. Seed yield per feddan showed the same trend as per plant in all cases. Many investigators reported that mineral NPK increased seed yield such as Azizi *et al* (2008) on cumin and Mollafilabi *et al* (2010) on *black cumin*. They found that increase seed yield per plant While, Azizi (2002) on anise, Ayub *et al* (2011) on *Foeniculum vulgare Mill* and Nowak (2011) on coriander. They found that mineral NPK increase seed yield per feddan.

**Table (1): Seed yield of *Nigella stiva* , L. as affected with different plant densities and fertilizer treatments during 2010-2011 and 2011 - 2012 seasons**

fertilizers Plant Density ( Per plot)	Seed yield (g/plant)									
	2010-2011 season					2011-2012 season				
	Control	NPK	CM	Foliar	Mean	Control	NPK	CM	Foliar	Mean
Low ( 20-plant)	8.27	19.91	10.55	9.24	11.99	4.93	6.59	5.98	5.98	5.72
Medium ( 40- plant)	7.68	8.31	10.77	12.13	9.72	5.03	5.58	5.89	4.23	5.18
High ( 80-plant)	9.30	10.66	7.60	10.85	9.62	4.00	6.13	4.98	4.79	4.98
Mean	8.42	12.96	9.64	10.74		4.65	6.17	5.62	5.00	
L.S.D <sub>0.05</sub>	Density- 2.41		Fertilization 4.40	Interaction 7.14		Density- 0.17		Fertilization 0.61	Interaction 1.79	

fertilizers plant Density ( Per plot)	Seed yield (kg/fed)									
	2010-2011 season					2011-2012 season				
	Control	NPK	CM	Foliar	Mean	Control	NPK	CM	Foliar	Mean
Low ( 20-plant)	441	1062	532	493	632	263	349	319	319	934
Medium ( 40- plant)	819	886	1149	1294	1037	536	595	629	451	1781
High ( 80-plant)	1984	2274	1621	2315	1959	996	1308	1062	1021	1982
Mean	1081	1407	1101	1367		598	751	670	597	
L.S.D <sub>0.05</sub>	Density- 676		Fertilization 319	Interaction 723		Density- 569		Fertilization 129	Interaction 487	

The interaction among plant density and different fertilizer treatments showed a significant increase in seed yield per plant during both seasons. The best production of seed yield was obtained with the low plant density and mineral NPK. These results are in agreement with those reported by Azizi *et al* (2008) on cumin, Mollafilabi *et al* (2010) on black seed and Nourouzpour *et al* (2011) on black seed.

Average of volatile oil (ml/plant) as affected by plant density and fertilizer treatments are presented in Table (2) and Fig (2). Results cleared that the low plant density treatment produced the highest volatile oil (ml/plant) 54% and 60% increases compared with high plant

density during both seasons. The results are in harmony with Mirshekari (2010) On *Cuminum cyminum* L., Nourouzpour *et al* (2007) on black cumin.

Mineral NPK treatment significantly increased volatile oil (ml/plant) and (L/fed.) in seeds during both seasons compared with untreated plants (Table ,2 and Fig ,2) . However, the maximum increase resulted with mineral NPK 44 % & 35% compared with control during the first and second seasons, respectively. Some authors found that mineral NPK increased volatile production; Tuncurk *et al* (2005) on *Nigella sativa*, L. plant and Moosavi *et al* (2012) on fennel.

The interaction among plant densities and the different fertilizer treatments showed that the highest yield of both seeds and volatile oil per feddan ,generally, resulted with the high plant density accompanied

with mineral NPK fertilization ; Nakhaei *et al* ( 2012) found that the high plant density and mineral NPK fertilization gave best production of both seeds and volatile oil (kg/fed).

**Table (2): Volatile oil yield of *Nigella sativa*, L. plant as affected with different plant densities and fertilizer treatments during 2010-2011 and 2011 – 2012 seasons**

Fertilization Plant Density ( Per plot)	Volatile oil (ml/plant)													
	2010-2011 season					2011-2012 season								
	Control	NPK	CM	Foliar	Mean	Control	NPK	CM	Foliar	Mean				
Low ( 20-plant)	0.60	1.00	0.98	0.83	0.85	0.88	0.98	0.99	0.95	0.95				
Medium ( 40-plant)	0.40	0.98	0.50	0.85	0.68	0.33	0.88	0.50	0.50	0.55				
High ( 80-plant)	0.38	0.46	0.35	0.40	0.39	0.30	0.45	0.40	0.38	0.38				
Mean	0.46	0.82	0.61	0.69		0.50	0.77	0.63	0.61					
L.S.D <sub>0.05</sub>	Density- 0.399			Fertilization 0.362		Interaction N.S		Density- 0.424			Fertilization N.S		Interaction N.S	

Fertilizers Plant Density ( Per plot)	Volatile oil (kg/fed.)													
	2010-2011 season					2011-2012 season								
	Control	NPK	C.M	foliar	Mean	control	NPK	C.M	foliar	Mean				
low(20-plan)	3.19	5.33	5.22	4.43	4.54	4.69	5.23	5.28	5.07	5.07				
medium(40-plant)	4.27	10.45	5.33	9.07	7.28	3.52	9.38	5.33	5.33	5.89				
High(80-plant)	8.12	9.81	7.47	8.53	8.48	6.39	9.59	8.53	8.12	8.16				
Mean	5.19	8.53	6.00	7.34		4.89	8.07	6.38	6.17					
L.S.D <sub>0.05</sub>	Density- 4.59		Fertilization 2.69			Interaction 6.14		Density- 3.82		Fertilization 2.04			Interaction 6.04	

### References:

Akhani A., M. T. Darzi . and H. S. H. Mohammadreza (2012) : Effect of biofertilizer and plant density on yield components and seed yield of coriander (*Coriandrum sativum* L.). International Journal of Agriculture and Crop Sciences, 4(16)1205-1211

Anonymous (1961): Egyptian Pharmacopoeia General Organization of Governmental Press Affairs.

Ayub M., M. Naeem, M. A. Nadeem, A. Tanveer, M.Tahir1 and R. Alam (2011): Effect of nitrogen application on growth, yield and oil contents of Fennel (*Foeniculum vulgare* Mill.) , Journal

- of Medicinal Plants Research 5(11): 2274-2277
- Azizi K. and D. Kahrizi (2008): Effect of nitrogen levels, plant density and climate on yield quantity and quality in Cumin (*Cuminum cyminum* L.) under the conditions of Iran. Asian Journal of Plant Sciences, 7 (8): 710-716
- Aziz S.(2002):Effect of N-fertilizer and sowing date on the growth ,seed yield and essential oil of anise. Miscellaneous and Industrial Crops, 72 (2):79-88
- Darzi T. M. (2012): Influence of organic manure and Bacterium of *Bacillus Circulans* in Anise (*Pimpinella anisum*). International Journal of Agriculture Crop Sciences, 4(2):64-69
- Ehsanipoura A., J. Razmjooa and H.Zeinalib (2012) :Effect of nitrogen rates on yield and quality of fennel(*Foeniculum vulgare Mill*) accessions Isfahan Agriculture Center Research,Iran, 35(1):121-125
- Menaria B.L. and Maliwal(2007): Maximization of seed yield in transplanted fennel (*Foeniculum vulgare Mill.*). Journal of Spices and Aromatic Crops , 16(1): 46-49
- Mirshekari B.(2010):Phenology essential oil yield and quality of cumin (*Cuminum cyminum* L) affected by sowing date and plant densities. Journal Horticulture, Environment and Biotechnology, 51(5) 373-377
- Mollafilabi A., H. Moodi, M. H. Rashed, and M. Kafi (2010): Effect of plant density and nitrogen on yield and yield. Components of black cumin (*Nigella sativa* L.). Acta Hort. (ISHS) 853:1(30)115-126
- Moosavi S. G. (2012): Flower fertility, yield and agronomical nitrogen use efficiency of fennel as affected by irrigation and nitrogen fertilizer rates, Technical Journal of Engineering and Applied Sciences,1(4):101-106
- Nakhaei A., S.G. Moosavi ,R. Baradaran and A. A. Nasrabad (2012); Effect of nitrogen and plant density levels on yield and yield components of fennel (*Foeniculum vulgare* L.), International J. of Agriculture and Crop Sciences,4(12):803-810
- Nourouzpour GH. and M. P. Rezvani (2007):Effect of different irrigation intervals and plant density on oil yield and essential percentage of black cumin (*Nigella sativa* L.), 73 In Natural Resources,19(4)133-138
- Nowak J. and W. Szemplinski (2011): Effect of nitrogen and Boron fertilization on the morphometric features and yield of coriander (*Coriandrum sativum* L.), Acta Pol., Agricultura Sci,10 (3): 111-118.
- Sedigheh S. , A. Rahnavard and Z. Y. Ashrafi (2009):The effect of plant density and sowing date on yield of basil (*Ocimum basilicum* L.) in Iran. Journal of Agriculture Technology, 5(2) 413-422
- Shah S. H. (2007): Synergistic responses of black cumin (*Nigella sativa* L.) and Kinetin spray. Journal of herbs, spices & Medicinal plants, 13(4) : 45-54
- Tuncturk M., R.Tuncturk and B.Yildirm (2011): The effects of varying Phosphorus dose on yield and some yield compo-

- nents of Black cumin (*Nigella sativa* L.), *Advance in Environmental Biology*,5(2) :371-374.
- Tuncturk M. ,Z. Ekin and D. Turozu (2005):Response of black cumin (*Nigella sativa* L.)to different seed rates growth yield components and essential oil content. *Journal of Agronomy*, 4(3)216-21
- Tuncturk R., M. Tuncturk and V. Ciftci (2012): The effect of varying Nitrogen does on yield and some yield components of black cumin (*Nigella sativa* L.) , *Advance in Environmental Biology*,6(2):855-858
- Valadabadi A. S. and H. A. Farahani (2011): Investigation of biofertilizers influence on quantity and quality characteristics in *Nigella sativa* L., *Journal of Horticulture and forestry*,3(3) :88-92
- Zareie H. M. , S. G. R. Moosavi and M. J. Seghatoleslami(2012): Effect of sowing date and plant density on yield and yield components of *Coriandrum sativum* L., *International Journal of Agriculture Research*

تأثير التسميد والكثافة النباتية على انتاجيه البذور والزيت الطيار لحبة البركه  
بوسى محمد القاضى ، جمال طه موسى ، محمد مصطفى جاد و عصمت فاروق على،  
قسم نباتات الزينه- كلية الزراعة - جامعه اسيوط

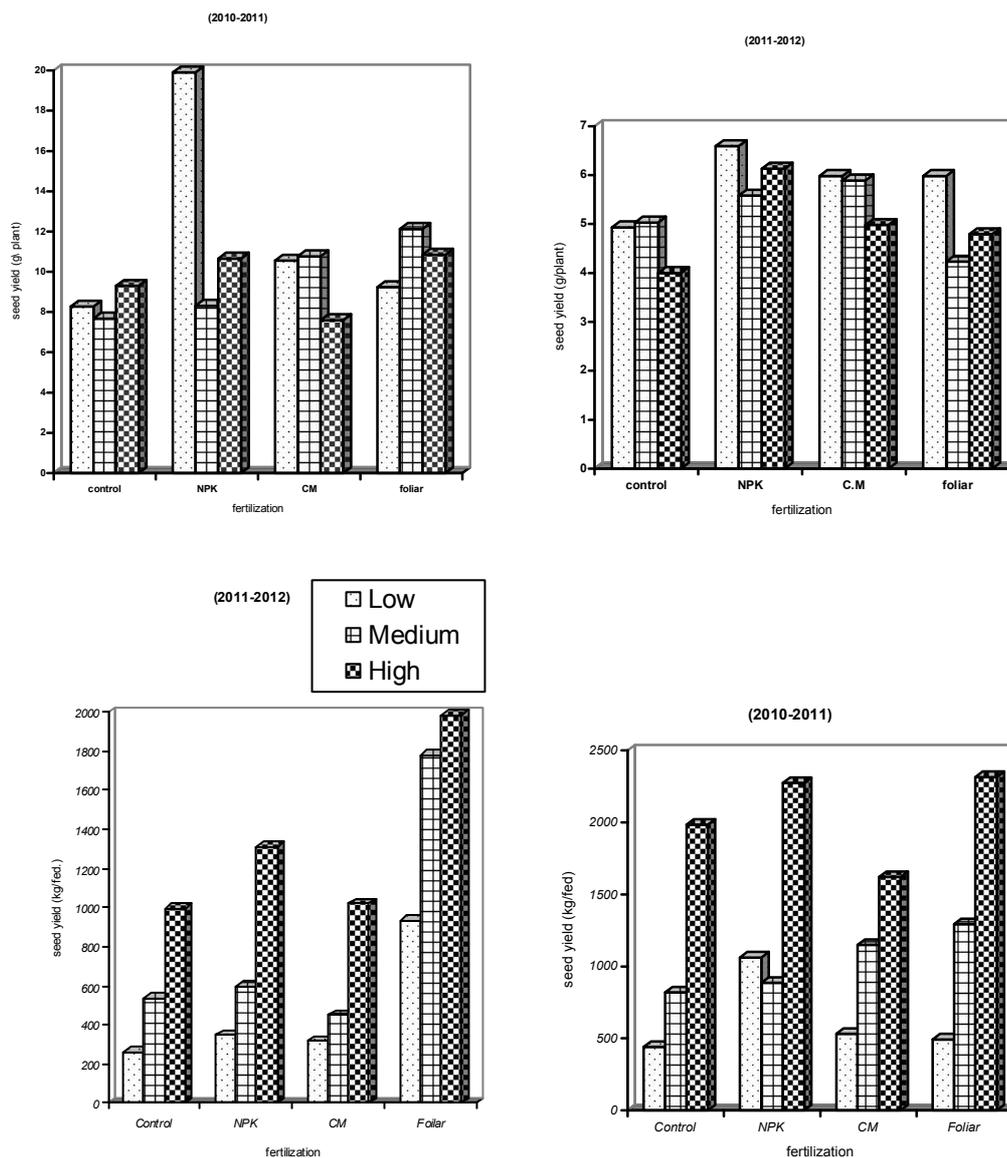
**الملخص:**

اجريت التجربه بمزرعه جامعه اسيوط خلال الموسمين ٢٠١٠-٢٠١١ ، ٢٠١١-٢٠١٢ على نبات حبة البركه وكان الهدف هو الحصول على أعلى محصول من البذور والزيت الطيار بدراسه ثلاث معاملات مختلفه من الكثافه النباتيه : منخفضه ( ٢٠ نبات )، متوسطه ( ٤٠ نبات ) ، عاليه ( ٨٠ نبات ) وذلك لوحده المساحه بالتجربه ( ١ × ١,٥ م<sup>٢</sup> ) وكذلك أربع معاملات سماديه تشمل : معاملته مقارنه (بدون تسميد)، السماد المعدنى (ن فوبو بمعدل ٧٠ كجم /فدان ) ، سماد الماشيه ( ٣٠ م<sup>٣</sup>/ فدان ) ، السماد الورقى توب ستار(ن فو بو + عناصر صغرى بمعدل ٢ جم /لتر ) .

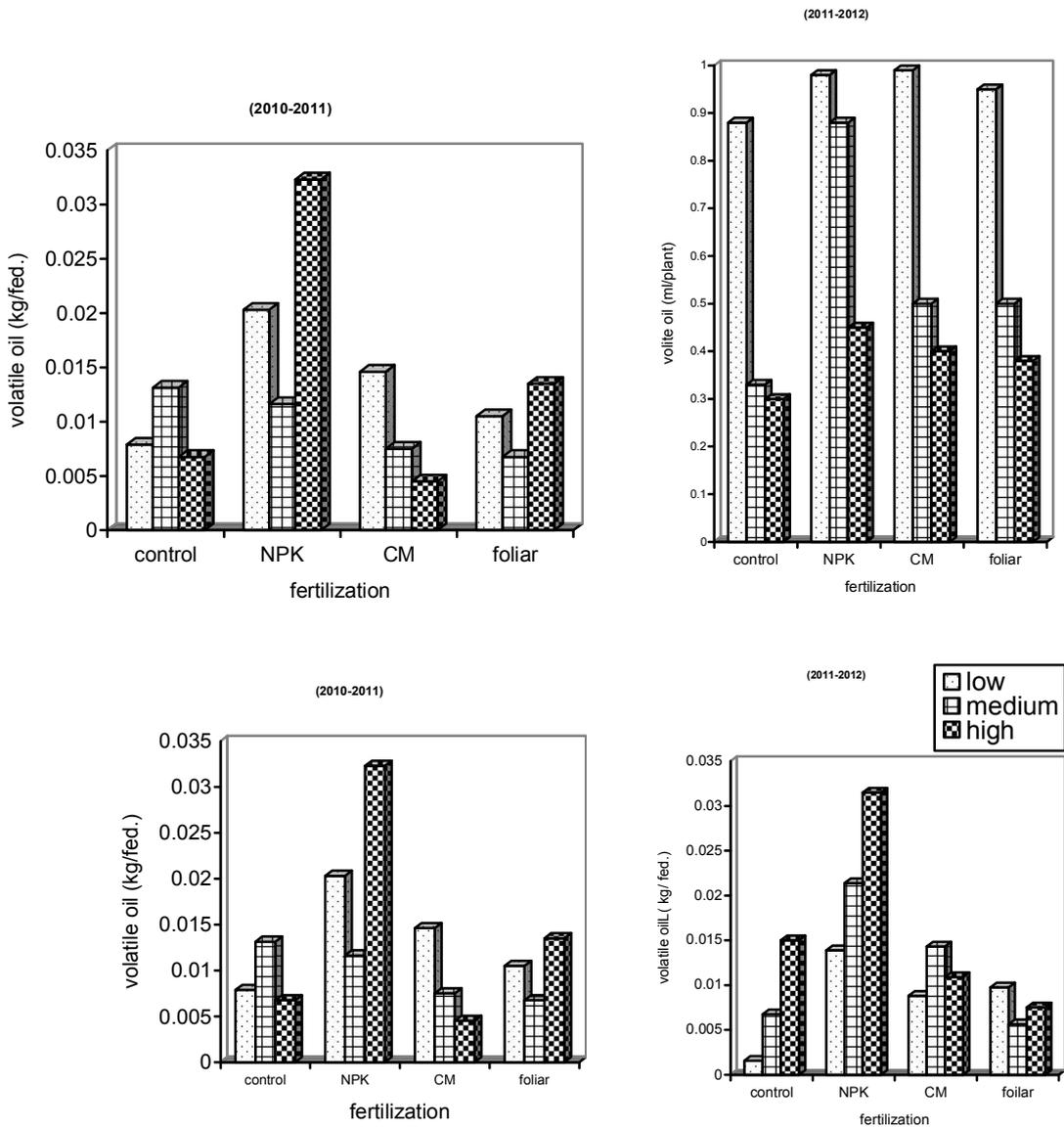
وقد اوضحت نتائج المعاملات ما يلى :

- أن الكثافه النباتية المنخفضه أعطت أعلى انتاج لكل من البذور والزيت الطيار كمتوسط للنبات الواحد يليها الكثافه النباتيه المتوسطه ثم العاليه وكانت الفروق معنويه فى معظم الحالات. أن استعمال السماد المعدنى ن فو بو أعطى أعلى انتاج لكل من البذور والزيت الطيار كمتوسط للنبات الواحد وكانت الفروق معنويه بالمقارنه بالنباتات التى لم يضاف اليها اسمده . بالرغم ان سماد الماشيه اعطى بعض الزيادة الا ان الفروق لم تكن مؤكده -بالنسبه لمحصول الفدان اظهرت النتائج ان كل من الكثافة النباتيه العاليه والتسميد المركب ن فو بو اعطى أعلى انتاج من كل من البذور والزيت الطيار وكانت الزيادة مؤكده بالمقارنه بالمعاملات الاخرى .

-أظهر التأثير المتبادل بين معاملات الكثافه النباتيه و معاملات التسميد المختلفه أن أعلى محصول للفدان لكل من البذور والزيت الطيار بصفه عامه نتج عن استعمال الكثافه النباتيه العاليه مع التسميد بالسماد المعدنى ن فو بو .



**Fig(1):** Seed yield (g/plant)& (kg/fed) of *Nigella stiva*, L affected with different plant densities and fertilizer treatments during 2010-2011 and 2011 - 2012 seasons



**Fig(2):** Volatile (ml/plant )&(l/fed) of *Nigella sativa* L affected with different plant densities and fertilizer treatments during 2010-2011 and 2011-2012