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INFLUENCE OF COMPOST AND BIO AND / OR MINERAL NPK FERTILIZATION ON LAVANDULA OFFICINALIS PLANTS

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ABSTRACT

This experiment was carried out during 2011 and 2012 seasons at the Nursery of Ornamental plants, Fac. Agric., Minia Univ. in order to investigate the effect of compost and bio. and / or mineral NPK fertilization treatments on yield of herb , essential oil and chemical composition of *Lavandula officinalis* plants. The obtained data revealed that the fresh and dry weights of herb per plant per cut or per plant per season, as well as, essential oil (% and yield / plant / cut and / plant / season) and chemical constituents (Total chlorophylls and percentages of N, P and K) were significantly increased due to the application of all used levels of compost. The maximum values were recorded at the high compost level (30%). Fresh and dry weights of herb (in both cuts and yield of herb / plant /season), essential oil productivity parameters and chemical determinations were significantly augmented as a result of using all bio. and / or mineral NPK fertilization treatments. The most effective treatments in this concern was E.M. + 75 % N and mineral N (full dose). It could be recommended to supply lavender plants with compost (30 % v/v) in combination with E.M. + 75% N or with mineral N (full dose) to maximize herb and essential oil productivity and chemical constituents for plants grown in sandy soil.

INTRODUCTION

Lavender (*Lavandula officinalis*, Chaix.) which belongs to Fam. Lamiaceae is an important multidisciplinary aromatic plant with great use in pharmaceutical, fragrance and food industries and for aromatic garden design.

Many authors studied the effect of organic fertilization on different aromatic plants such as Gharib *et al.* (2008) on marjoram plants, Hendawy *et al.* (2010) on *Thymus vulgaris* and Abdou *et al*. (2011 and 2012) on clove basil and *Mentha piperita*, respectively. they indicated that the application of compost significantly

increased all vegetative growth traits, essential oil production and various chemical constituents.

Mineral fertilization, as well as, biofertilization are among the important agricultural treatments which have been proved to improve and augment vegetative growth, oil production and chemical constituents on aromatic plants, i.e. Biesiada *et al*. (2008) on *lavandula angustifolia*, El-Shora (2009) on *Mentha piperita*, Ibrahim (2010) on geranium plants and Marzok (2011) on *Ocimum gratissimum* who concluded that NPK treatment significantly increased all vegetative growth traits, essential oil yield and chemical composition (pigments and N, P and K %).

Regarding the use of biofertilizers, Mazrou (2008) on *Cembopogon citratus*, Erika *et al* (2008) on marjoram plants, Ali (2012) on *Melissa officinalis.* and Abdou *et al*. (2012b) on *Salvia officinalis* found that biofertilizer treatments increased plant height, stem diameter, branches number, herb fresh and dry weights / plant, oil production (oil % and yield), as well as, photosynthetic pigments (chl. a, b and carotenoids) and the percentages of N, P and K.

So, the current experiment aimed to study the influence of compost and bio and / or mineral NPK fertilization treatments. on yield of herb, oil productivity and some chemical constituents of *Lavandula officinalis*, Chaix. Plants.

MATERIALS AND METHODS

This investigation was carried out during the two successive seasons of 2011 and 2012 at the Floriculture Nursery and in the Laboratory of Floriculture, Fac. of Agric., Minia Univ.

Seedlings of lavender at the stage of 5-6 leaves and 8 – 10 cm in height were transplanted on Feb. 23th, for both experimental seasons to black plastic bag (30 cm diameter) containing 20 kg of sandy soil in both season which were analyzed according to Jakson (1973) and are shown in Table (a).

The current experiment contained 40 treatments, every treatment replicated 3 times, in every replicate 4 bags (seedling / bag) in a split-plot in completely randomized design. The main plots included four levels of compost (0, 10, 20 and 30 % compost: sand v/v), while, ten bio and / or mineral NPK fertilization treatments (control, N at 50, 75 and 100 % plus constand dose of PK, E.M. + 50 % N plus PK, E.M. + 75 % N plus PK, M.A., M.A. + 50 % N plus M.A. + 75 % N plus PK) occupied the subplots.

The used compost was obtained from the Egyptian Co. for solid Waste Utifization, New Minia City. Compost was added during filling the bags in the two seasons. Physical and chemical properties of the used compost are shown in Table (b).

Fresh and active tow biofertilizers namely Effective microorganisms (E.M.) and Minia Azotien (M.A.) were obtained from the Laboratory of Biofertilizers, Dept. of Genetics, Fac. of Agric., Minia Univ. Biofertilizers were applied four times, twice before first cutting (March 21st and April 15th) and twice after the first cutting (August 18th and September 8th). to the soil around each plant (50 ml / bag, 1 ml = 10^7 cells).Seedlings were irrigated immediately after each treatment.

The mineral N_3PK were 12 g / bag of ammonium sulphate (20.6 % N) + 8 g/bag

of calcium superphosphate (15.5 % P_2O_5) + 4 g / bag of potassium sulphate (48 % K_2O) as recommended dose, while 75 % N_2 + PK (N_2PK) were 9 + 8 + 4 g / bag, respectively and 50 % N + PK (N_1PK) were 6 + 8 + 4 g / bag, respectively.

The amounts of NK fertilizers were divided into four equal batches and added at March 20th, April 22nd, August 25th and September 15th in both seasons. While the amounts of P were divided into two equal doses and added with the first and third dose of NK. All other agricultural practices were carried out as usual in the region during both seasons.

Table (a): Physical and chemical properties of the used soil before transplanting lavender plants during 2011 and 2012 season.

Character		Value	
		2011	2012
Sand %		88.00	89.00
Silt %		8.30	7.40
Clay %		3.70	3.60
texture		Sandy soil	Sandy soil
Ca Co_3 %		14.91	14.91
pH (1: 2.5)		8.17	8.21
Organic matter %		0.06	0.05
E.C.(m mhos/ cm)		1.09	1.11
Total N %		0.02	0.02
Available P %		3.25	3.56
Extr. K (mg/100 g soil		0.90	1.01
	Fe	1.10	1.18
DTPA	Cu	0.39	0.43
Ext.ppm	Zn	0.36	0.30
	Mn	0.60	0.71

Table(b): Physical and chemical properties of the used compost.

Properties	Value	Properties	Value
Dry weight of 1 m^3	450 Kg	C/N ratio	14.1 – 18.5
Fresh weight of 1 m^3	650-700 Kg	NaCl %	1.1 – 1.75
Moisture %	25 - 30	Total P %	0.5 – 0.75
pH (1 : 10)	7.5 - 8	Total K %	0.8 – 1.0
E.C. (m.mhose / cm)	2 - 4	Fe ppm	150 - 200
Total N %	1 – 1.4	Mn ppm	25 - 56
Org . matter %	32 - 34	Cu ppm	75 - 150
Org .carbon %	18.5 – 19.7	Zn ppm	150 - 225

Harvesting:

During each experimental season the plants were cut two times. In each harvest, the plants were cut leaving about 7 cm. above the soil surface. The first cut was done on 19th of July and the second cut

was done on 1st November in the two growing seasons.

At the harvesting time of each cut, the following data were recorded: fresh and dry weights of herb / plant / cut and per plant per season.

Oil percentage in the fresh herb of each treatment (60g) was carried out in each cut during the two experimental seasons according to the method described by British pharmacopoeia (1963) and essential oil yield / plant / cut and / plant / season was calculated.

Total chlorophylls were determined in the fresh leaves on the 7th of October for both seasons according to Moran (1982) and N, P and K % in the dry herb were estimated according to cottenie *et al.* (1982). All obtained data were statistically analyzed using MSTAT- C (1986). L.S.D at 0.05 was used to compare the means of treatments.

RESULTS AND DISCUSSION

A- Herb fresh and dry weights / plant / cut and per plant / season.

Data presented in Tables (1, 2 and 3) indicated that all used compost fertilization treatments significantly increased herb fresh and dry weights / plant / cut, as well as, yield of herb fresh and dry weights / plants / season over those of the control. The increase in herb weight was gradual with the gradual increase of compost fertilization level. Where, the high level of compost (30 %) resulted in the heaviest herb fresh weight / plant either in the two cuts or per plant per season during both seasons. The stimulatory effect of compost on the herb weight may be due to that these fertilizers gave better growth that reflected on fresh weight, as well as, better photosynthesis, consequently more carbohydrates and dry matter accumulation. These results agreed with those obtained by Gharib *et al.* (2008) on marjoram plants, Hendawy *et al.* (2010) on *Thymus vulgaris* and Abdou *et al.* (2011 and 2012a) on clove basil and *Mentha piperita*, respectively.

All nine fertilization treatments (bio. and / or mineral NPK fertilization) gave significantly heavier fresh and dry herb / plant / cut and / plant / season than the unfertilized plants in the two seasons. Moreover, the two treatments of E.M. + 75 % N (N_2PK) dose and N (full dose "N_3PK") produced significantly heavier weight than other treatments without significant differences between them in all cases. The stupendous effect of the treatment of E.M. + 75 % N or mineral N (full dose) may be due to the role of biofertilizer and NPK on improving plant physiological processes, as well as, components metabolic that reflected on herb fresh weight consequently increased herb dry weight. Many investigators revealed that biofertilization caused an increase in herb yield such as Mazrou (2008) on *Cembopogon citratus*, Ali (2012) on *Melissa officinalis* and Abdou *et al*. (2012b) on sage plants.

The interaction between main and sub plots (A × B) was significant for herb fresh and dry weights / plant / cut and / plant / season in both growing seasons. The highest values for all previous parameters were due to the application of high percent of compost (30 %) in combination with E.M. + 75 % N (N_2PK) or mineral N (full dose "N_3PK") in all cases and with M.A. + 75 % N (N_2PK) in some cases. improving effect on plant growth consequently increased oil content (Meyer *et al.*, 1973). In agreement with

these finding were those of El-Sanafaway (2007) and Abdou *et al.* (2011) on *Ocimum* gratissimum. and Shala (2007) on sage plants.

The interaction between main and sub plot treatments had significant effect on essential oil % in all cases, except in the first cut during the first season. The maximum values of essential oil % were resulted from the interaction treatments of compost (30 %) with E.M. + 75 % N (N_2PK) or E.M. + 50 % N (N_1PK), mineral N (full dose "N_3PK") and E.M. alone in all cases or with mineral N (75 %) in the second cut for the first season and first cut in the second season or with M.A. +75 % N(N_2PK) in the two cuts during the second season (Table, 4).

2- Essential oil yield / plant / cut and plant / season.

Data presented in Tables (5 and 6) revealed that the three levels of compost increased essential oil yield either per plant in both cuts or per plant per season significantly during the two growing seasons over the control plant. The most effective treatment, which gave the greatest essential oil yield, was the high level of compost (30 %). The stimulatory effect of compost treatments in increasing essential oil % and fresh weight of herb. Similar results were also reported by Gharib *et al.* (2008) on marjoram plants, Hendawy *et al*. (2010) on *Thymus vulgaris* and Abdou *et al.* (2012a) on *Mentha piperita.*

The obtained results in Tables (5 and 6) proved that the use of any bio and / or NPK treatments led to a significant increase in the yield of essential oil (per plant per cut and per plant per season) in both seasons.

The greatest essential oil yield was resulted from the treatments of E.M. + 75 % N (N_2PK) followed by mineral N (100 % "N_3PK") without significant differences between such two superior treatments. The superiority effect of the two treatments of E.M. +75 % N (N_2PK) or mineral N (100 % "N_3PK ") may be to the increase in their fresh weight and essential oil %. In this respect, Yousef (2005) on lemon balm stated that treated plants with biofertilizers improved essential oil yield. Moreover Maria and Barbieri (2006) on sweet basil found that all dose of NPK plus biofertilizer increased oil yield.

The interaction between compost, and bio. and / or mineral NPK fertilization treatments was significant for essential oil yield / plant / season and oil yield / plant / cut in both seasons, except the first cut during the first season. The highest values of essential oil yield / plant / cut were obtained from lavender plants fertilized with compost (30 %) in combination with E.M. + 75 % N (N_2PK) or with mineral N (full dose) (Table, 5). Moreover, the highest values of essential oil yield / plant / season over were obtained due to compost at 30 % in combination with E.M. + 75 % N (N_2PK) followed by 30 % compost × mineral N (100 %"N_3PK") in the first season or 30 % compost × E.M. + 75 % N (N_2PK) in the second season, (Table 6).

Chemical composition:

1- Total chlorophylls:

Data presented in Table (7) indicated that the contents of total chlorophylls in the fresh leaves of lavender plants were considerably improved as a result of organic fertilization with different levels of compost when compared with control.

The highest chlorophylls content was resulted from lavender received compost at 30 % in both seasons. This result may be attributed to the increase in nutrient elements, cytokinins and Mg which came as a result from adding organic fertilizer, that reflected on the pigments content. These results are in accordance with those obtained by El-Ghadban *et al.* (2008) on lavender plants.

Also, data in Table (7) indicated that all used nine fertilization treatments significantly increased total chlorophylls over control in both seasons. The highest values were obtained from the treatments of E.M. + 75 % N (N2PK) followed by 100 % mineral N (N3PK) without significant differences between them. These results may be due to the Effective microorganisms which plays an important role in chlorophylls synthesis (Dixon, 1990). In agreement with our results concerning biofertilizer were revealed by El-Ghadban et al. (2008) on lavender plants. While, NPK fertilizer was effective on increasing pigments content as reported by Biesiada et al. (2008) on Lavandula angustifolia.

The interaction treatments were significant for total chlorophylls in both seasons. The highest contents were obtained with compost at 30 % in combination with E.M. + 75 % N (N_2PK) or with mineral N (100 %" N_3PK").

Data presented in Tables (7 and 8) revealed that the three levels of compost significantly increased N, P and K % in the dry herb of lavender plants, in both season, in comparison with the control treatment. The highest herb N, P and k % were obtained from high percent of compost (30 %) during both seasons. The increment in N, P and K % by using the compost may be due to increasing the occupancy root zone of plant as a result of adding compost and its analyzing which reflected on such elements uptake by plants. Similar results were obtained by Abdou *et al.* (2011 and 2012 a) on clove basil and mint plants, respectively.

In regard to the sub plot treatments, significant differences were obtained in N, P and K % in lavender herb, due to such nine used treatments over those of untreated plants in both seasons. The best results were obtained due to the use of mineral N (100 % "N_3PK") followed by E.M. + 75 % N (N_2PK) then M.A. + 75 % N (N_2PK) for N, P and K %. The superiorty of treatments of full dose of N or 75 % N plus biofertilizer on N, P and K % may be attributed to increasing available NPK elements in root zone as a result of adding NPK fertilizers and inoculation with biofertilizer which reflected on N, P and K uptake. these results are in accordance with those obtained by El-Leithy *et al.* (2006) on rosemary plants and Biesiada and Kus (2010) on basil plants.

The interaction between main and sub plots (A × B) was significant in both seasons for N and K %, except in the second season for K %. Also, the interaction was not significant for P % in both seasons. However, the interaction treatments of compost (30 %) with mineral N (100 % "N_3PK") or with E.M. + 75 % N (N_2PK) gave generally the highest values of N and k % in both seasons.

Table (1): Effect of compost, bio. and / or mineral NPK fertilization on herb fresh weight / plant / cut (g / plant) of *lavandula officinalis,* Chaix. during 2011 and 2012 seasons.

bio. and / or mineral NPK fertilization	Herb fresh weight / plant / cut (g / plant)									
	First season									
	First Cut					Second Cut				
	Comp. 0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)	Comp.0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)
Control	23.1	39.2	46.1	55.7	41.0	48.8	79.8	94.6	108.6	83.0
100% N (N_3PK)	42.3	64.7	78.5	92.3	69.5	84.1	125.1	150.4	161.7	130.3
75% N (N_2PK)	36.9	57.4	69.5	82.1	61.5	74.4	112.6	138.7	152.2	119.5
50% N (N_1PK)	29.0	47.8	56.5	66.7	50.0	60.4	97.6	116.8	131.0	101.5
E.M.	27.5	46.0	53.1	62.4	47.3	56.0	89.9	106.9	120.0	93.2
E.M.+75%N (N_2PK)	42.8	65.2	79.0	93.4	70.1	84.9	126.0	151.8	163.6	131.6
E.M.+50%N (N_1PK)	33.9	53.4	64.7	76.5	57.1	68.0	107.4	128.8	138.5	110.7
M.A.	24.4	44.4	50.1	59.1	44.5	52.1	84.9	103.4	115.5	89.0
M.A.+75%N (N_2PK)	39.5	61.0	73.9	87.4	65.5	80.1	120.1	144.7	159.3	126.1
M.A.+50%N (N_1PK)	31.4	51.2	60.5	71.5	53.7	64.2	102.5	122.8	137.7	106.8
Mean (B)	33.1	53.0	63.2	74.7		67.3	104.6	125.9	138.8	
L.S.D at 5%	A: 0.52 B: 0.60 AB: 1.20					A: 1.05 B: 1.30 AB: 2.60				
	Second season									
Control	25.7	42.9	50.1	60.5	44.8	52.1	85.4	100.8	116.2	88.6
100% N (N_3PK)	47.1	74.2	87.6	101.9	77.7	86.9	133.5	159.7	181.0	140.3
75% N (N_2PK)	42.3	67.3	78.6	83.7	68.0	80.6	125.5	148.5	168.5	130.8
50% N (N_1PK)	33.2	54.5	63.4	75.0	56.5	66.6	107.2	126.4	142.3	110.6
E.M.	32.1	52.0	60.2	69.9	53.6	65.7	104.3	122.0	135.2	106.8
E.M.+75%N (N_2PK)	46.6	75.3	88.2	103.1	78.3	85.6	135.4	161.2	183.1	141.3
E.M.+50%N (N_1PK)	38.5	62.4	72.8	85.6	64.8	74.7	118.4	140.1	156.6	122.5
M.A.	28.6	47.6	56.0	65.1	49.3	58.5	95.2	113.2	125.0	98.0
M.A.+75%N (N_2PK)	44.7	69.6	80.5	95.0	72.5	83.7	127.3	149.5	171.6	133.0
M.A.+50%N (N_1PK)	36.3	58.6	68.3	80.8	61.0	71.6	113.3	133.8	150.5	117.3
Mean (B)	37.5	60.4	70.6	82.1		72.6	114.6	135.5	153.0	
L.S.D at 5%	A: 0.64 B: 0.90 AB: 1.80					A: 0.85 B: 1.01 AB: 2.02				

Comp. = Compost; E.M. = Effective microorganisms; M.A. = Minia Azotein

Table (2): Effect of compost, bio. and / or mineral NPK fertilization on herb dry weight / plant / cut (g / plant) of *lavandula officinalis,* Chaix. during 2011 and 2012 seasons.

bio. and / or mineral NPK fertilization	Herb dry weight / plant / cut (g / plant)									
	First season									
	First Cut					Second Cut				
	Comp. 0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)	Comp.0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)
Control	7.16	12.11	14.19	17.10	12.64	15.11	24.65	29.13	33.31	25.55
100% N (N_3PK)	13.11	19.93	24.11	28.25	21.35	25.90	38.40	46.00	49.32	39.91
75% N (N_2PK)	11.42	17.68	21.34	25.13	18.89	22.90	34.55	42.43	46.41	36.57
50% N (N_1PK)	8.96	14.72	17.35	20.41	15.36	18.60	29.95	35.73	39.92	31.05
E.M.	8.51	14.17	16.31	19.10	14.52	17.24	27.59	32.71	36.60	28.54
E.M.+75%N (N_2PK)	13.23	20.11	24.26	28.58	21.55	26.14	38.65	46.45	49.89	40.28
E.M.+50%N (N_1PK)	10.48	16.45	19.86	23.41	17.55	20.93	32.96	39.41	42.24	33.89
M.A.	7.54	13.68	15.39	18.09	13.68	16.10	26.15	31.73	35.32	27.33
M.A.+75%N (N_2PK)	12.22	18.80	22.69	26.75	20.12	24.67	36.85	44.25	48.58	38.59
M.A.+50%N (N_1PK)	9.71	15.78	18.57	21.88	16.49	19.77	31.46	37.56	41.98	32.69
Mean (B)	10.23	16.34	19.41	22.87		20.74	32.12	38.54	42.36	
L.S.D at 5%	A: 0.15	B: 0.24	AB: 0.48			A: 0.12	B: 0.37	AB: 0.74		
	Second season									
Control	7.97	13.26	15.43	18.58	13.81	16.04	26.22	30.84	35.44	27.14
100% N (N_3PK)	14.40	23.21	27.00	31.41	24.01	26.00	39.21	45.00	47.52	39.43
75% N (N_2PK)	13.07	20.72	24.13	25.61	20.88	24.31	37.75	44.51	47.18	38.44
50% N (N_1PK)	10.25	16.78	19.46	22.95	17.36	20.31	32.58	38.29	42.95	33.53
E.M.	9.92	16.02	18.48	21.39	16.45	20.10	31.81	37.05	40.94	32.48
E.M.+75%N (N_2PK)	14.39	23.19	27.07	31.54	24.05	25.68	39.27	45.14	47.61	39.43
E.M.+50%N (N_1PK)	11.91	19.22	22.35	26.19	19.92	22.63	35.75	42.17	45.41	36.49
M.A.	8.83	14.68	17.19	19.95	15.16	17.96	29.13	34.53	38.00	29.91
M.A.+75%N (N_2PK)	13.81	21.43	24.71	29.07	22.26	25.19	38.19	44.61	47.21	38.80
M.A.+50%N (N_1PK)	11.22	18.04	20.96	24.72	18.74	21.75	34.32	40.40	45.30	35.44
Mean(B)	11.58	18.66	21.68	25.14		22.00	34.42	40.25	43.76	
L.S.D at 5%	A: 0.25	B: 0.25	AB: 0.51			A: 0.20	B: 0.33	AB: 0.66		

Comp. = Compost; E.M. = Effective microorganisms; M.A. = Minia Azotein

Table (3): Effect of compost, bio. and / or mineral NPK fertilization on yield of herb fresh and dry weights / plant / season (g / plant) of *lavandula officinalis,* Chaix. during 2011 and 2012 seasons.

bio. and / or mineral NPK fertilization	Herb fresh weight / plant / season (g / plant)									
	First Season					Second Season				
	Comp. 0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)	Comp.0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)
Control	71.9	119.0	140.7	164.3	124.0	77.8	128.3	150.9	176.7	133.4
100% N (N_3PK)	126.4	189.8	228.9	254.0	199.8	134.0	207.7	247.3	282.9	218.0
75% N (N_2PK)	111.3	170.0	208.2	234.3	181.0	122.9	192.8	227.4	252.2	198.8
50% N (N_1PK)	89.4	145.4	173.3	194.7	150.7	99.8	161.7	189.8	217.3	167.2
E.M.	83.5	135.9	160.0	182.4	140.5	94.8	156.3	182.2	205.1	159.6
E.M.+75%N (N_2PK)	127.7	191.2	230.8	257.0	201.7	132.2	210.7	249.4	286.2	219.6
E.M.+50%N (N_1PK)	101.9	160.8	193.5	215.0	167.8	113.2	180.8	212.9	242.2	187.3
M.A.	76.5	129.3	153.5	174.6	133.5	87.1	142.8	166.2	190.1	146.6
M.A.+75%N (N_2PK)	119.6	181.1	218.6	252.7	193.0	128.5	196.9	230.0	266.6	205.5
M.A.+50%N (N_1PK)	89.6	153.7	183.3	209.2	159.0	107.9	171.9	202.1	231.3	178.3
Mean (B)	99.8	157.6	189.1	213.8		109.8	175.0	205.8	235.1	
L.S.D at 5%	A: 7.07 B: 7.62 AB: 15.24					A: 8.61 B: 12.53 AB: 25.06				
bio. and / or mineral NPK fertilization	Herb dry weight / plant / season (g / plant)									
	First Season					Second Season				
	Comp. 0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)	Comp.0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)
Control	22.27	36.76	43.32	50.41	38.19	24.01	39.48	46.30	50.02	39.95
100% N (N_3PK)	39.01	58.33	70.11	77.57	61.26	40.40	62.42	72.00	78.93	63.44
75% N (N_2PK)	34.32	52.23	63.77	71.54	55.47	37.38	58.47	68.64	72.79	59.32
50% N (N_1PK)	27.56	44.67	53.08	60.33	46.41	30.56	49.36	57.75	65.90	50.89
E.M.	25.75	41.76	49.02	55.70	43.06	30.02	47.83	55.53	62.33	48.93
E.M.+75%N (N_2PK)	39.37	58.76	70.71	78.47	61.83	40.07	62.46	72.21	79.15	63.47
E.M.+50%N (N_1PK)	31.41	49.41	59.27	65.65	51.44	34.54	54.97	64.52	71.60	56.41
M.A.	23.64	39.83	47.12	53.41	41.00	26.79	43.81	51.72	57.95	45.07
M.A.+75%N (N_2PK)	36.89	55.65	66.94	75.33	58.70	39.00	59.62	69.32	76.28	61.06
M.A.+50%N (N_1PK)	29.48	47.24	56.13	64.19	49.26	32.97	52.47	61.37	70.02	54.21
Mean (B)	30.97	48.46	57.95	65.26		33.57	53.09	61.94	68.50	
L.S.D at 5%	A: 1.19 B: 1.57 AB: 3.14					A: 1.06 B: 1.45 AB: 2.90				

Comp. = Compost; E.M. = Effective microorganisms; M.A. = Minia Azotein

Table (4): Effect of compost, bio. and / or mineral NPK fertilization on essential oil percentage / plant / cut of *lavandula officinalis,* Chaix. during 2011 and 2012 seasons.

bio. and / or mineral NPK fertilization	Essential oil percentage / plant / cut									
	First season									
	First Cut					Second Cut				
	Comp. 0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)	Comp.0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)
Control	1.8	2.0	2.1	2.3	2.05	1.9	2.1	2.3	2.4	2.18
100% N (N_3PK)	2.2	2.4	2.6	2.8	2.50	2.2	2.5	2.6	2.8	2.53
75% N (N_2PK)	2.2	2.3	2.4	2.7	2.40	2.2	2.4	2.4	2.7	2.43
50% N (N_1PK)	1.9	2.1	2.1	2.4	2.13	2.0	2.2	2.3	2.5	2.25
E.M.	2.1	2.4	2.6	2.7	2.45	2.1	2.5	2.6	2.7	2.48
E.M.+75%N (N_2PK)	2.2	2.5	2.6	2.9	2.55	2.2	2.6	2.7	2.9	2.60
E.M.+50%N (N_1PK)	2.2	2.4	2.5	2.8	2.48	2.2	2.5	2.6	2.7	2.50
M.A.	2.1	2.2	2.3	2.4	2.25	2.0	2.3	2.4	2.5	2.30
M.A.+75%N (N_2PK)	2.2	2.3	2.4	2.6	2.38	2.1	2.4	2.5	2.6	2.40
M.A.+50%N (N_1PK)	2.1	2.3	2.4	2.5	2.33	2.1	2.4	2.4	2.6	2.38
Mean (B)	2.10	2.29	2.40	2.61		2.10	2.39	2.48	2.64	
L.S.D at 5%	A: 0.09 B: 0.19 AB: N.S					A: 0.14 B: 0.12 AB: 0.24				
	Second season									
Control	1.9	2.2	2.3	2.3	2.18	1.9	2.2	2.3	2.4	2.20
100% N (N_3PK)	2.2	2.5	2.6	2.8	2.53	2.2	2.6	2.7	2.8	2.58
75% N (N_2PK)	2.2	2.4	2.5	2.7	2.45	2.2	2.4	2.6	2.7	2.48
50% N (N_1PK)	2.0	2.3	2.4	2.4	2.28	2.0	2.3	2.4	2.5	2.30
E.M.	2.1	2.5	2.6	2.7	2.48	2.1	2.6	2.7	2.8	2.55
E.M.+75%N (N_2PK)	2.2	2.5	2.6	2.9	2.55	2.2	2.6	2.7	3.0	2.63
E.M.+50%N (N_1PK)	2.2	2.5	2.6	2.7	2.50	2.2	2.3	2.6	2.8	2.50
M.A.	2.0	2.4	2.4	2.5	2.33	2.1	2.3	2.4	2.5	2.33
M.A.+75%N (N_2PK)	2.1	2.4	2.4	2.6	2.38	2.1	2.4	2.5	2.6	2.40
M.A.+50%N (N_1PK)	2.1	2.4	2.4	2.5	2.35	2.2	2.3	2.4	2.5	2.35
Mean (B)	2.10	2.41	2.48	2.61		2.12	2.40	2.53	2.66	
L.S.D at 5%	A: 0.11 B: 0.15 AB: 0.30					A: 0.09 B: 0.13 AB: 0.26				

Comp. = Compost; E.M. = Effective microorganisms; M.A. = Minia Azotein

Table (5): Effect of compost, bio. and / or mineral NPK fertilization on essential oil yield / plant / cut (ml) of *lavandula officinalis,* Chaix. during 2011 and 2012 seasons.

bio. and / or mineral NPK fertilization	Essential oil yield / plant / cut (ml)									
	First season									
	First Cut					Second Cut				
	Comp. 0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)	Comp.0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)
Control	0.354	0.784	0.968	1.280	0.846	0.927	1.675	2.175	2.606	1.846
100% N (N_3PK)	0.931	1.552	2.040	2.553	1.769	1.851	3.128	3.910	4.528	3.354
75% N (N_2PK)	0.812	1.321	1.669	2.218	1.505	1.637	2.704	3.328	4.108	2.944
50% N (N_1PK)	0.550	1.004	1.186	1.600	1.085	1.208	2.146	2.688	3.275	2.329
E.M.	0.490	1.104	1.380	1.685	1.165	1.177	2.249	2.778	3.238	2.361
E.M.+75%N (N_2PK)	0.942	1.630	2.054	2.709	1.834	1.868	3.274	3.536	4.743	3.355
E.M.+50%N (N_1PK)	0.746	1.281	1.617	2.142	1.447	1.497	2.685	3.346	3.740	2.817
M.A.	0.513	0.977	1.154	1.419	1.016	1.042	1.952	2.482	2.889	2.091
M.A.+75%N (N_2PK)	0.869	1.404	1.775	2.273	1.580	1.683	2.881	3.618	4.089	3.068
M.A.+50%N (N_1PK)	0.659	1.178	1.452	1.787	1.269	1.348	2.460	2.947	3.580	2.584
Mean (B)	0.687	1.224	1.529	1.967		1.424	2.515	3.081	3.680	
L.S.D at 5%	A: 0.271 B: 0.131 AB: N.S					A: 0.291 B: 0.161 AB: 0.322				
	Second season									
Control	0.489	0.944	1.153	1.391	0.994	0.990	1.880	2.317	2.794	1.995
100% N (N_3PK)	1.038	1.854	2.278	2.851	2.005	1.913	3.473	4.312	5.067	3.691
75% N (N_2PK)	0.931	1.616	1.966	2.261	1.693	1.773	3.011	3.861	4.268	3.228
50% N (N_1PK)	0.663	1.254	1.522	1.799	1.310	1.333	2.467	3.034	3.559	2.598
E.M.	0.674	1.299	1.565	1.888	1.357	1.381	2.712	3.295	3.786	2.794
E.M.+75%N (N_2PK)	1.024	1.881	2.294	2.989	2.047	1.882	3.520	4.353	5.489	3.811
E.M.+50%N (N_1PK)	0.847	1.562	1.892	2.311	1.653	1.643	2.961	3.643	4.386	3.158
M.A.	0.571	1.143	1.342	1.627	1.171	1.229	2.191	2.718	3.127	2.316
M.A.+75%N (N_2PK)	0.937	1.670	1.932	2.469	1.752	1.757	3.057	3.737	4.462	3.253
M.A.+50%N (N_1PK)	0.762	1.408	1.639	2.020	1.457	1.574	2.605	3.212	3.762	2.788
Mean (B)	0.794	1.463	1.758	2.161		1.548	2.788	3.448	4.070	
L.S.D at 5%	A: 0.271 B: 0.101 AB: 0.202					A: 0.242 B: 0.191 AB: 0.382				

Comp. = Compost; E.M. = Effective microorganisms; M.A. = Minia Azotein

Table (6): Effect of compost, bio. and / or mineral NPK fertilization on essential oil yield / plant / season (ml) of *lavandula officinalis,* Chaix. during 2011 and 2012 seasons.

bio. and / or mineral NPK fertilization	Essential oil yield / plant / season (ml)									
	First season					Second season				
	Comp. 0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)	Comp.0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)
Control	1.281	2.459	3.143	3.886	2.692	1.479	2.824	3.470	4.185	2.990
100% N (N_3PK)	2.782	4.680	5.950	7.081	5.123	2.950	5.327	6.591	7.918	5.697
75% N (N_2PK)	2.449	4.025	4.997	6.326	4.449	2.705	4.627	5.826	6.529	4.922
50% N (N_1PK)	1.758	3.150	3.874	4.876	3.415	1.997	3.721	4.556	5.358	3.908
E.M.	1.667	3.353	4.159	4.923	3.526	2.056	4.010	4.860	5.675	4.150
E.M.+75%N (N_2PK)	2.810	4.905	6.151	7.453	5.330	2.906	5.401	6.647	8.479	5.858
E.M.+50%N (N_1PK)	2.243	3.967	4.963	5.881	4.264	2.044	4.523	5.535	6.697	4.700
M.A.	1.555	2.929	3.636	4.309	3.107	1.800	3.333	4.060	4.754	3.487
M.A.+75%N (N_2PK)	2.552	4.285	5.394	6.362	4.648	2.694	4.727	5.670	5.931	4.756
M.A.+50%N (N_1PK)	2.007	3.638	4.399	5.367	3.853	2.336	4.012	4.851	5.782	4.245
Mean (B)	2.110	3.739	4.667	5.646		2.297	4.251	5.206	6.131	
L.S.D at 5%	A: 0.283	B: 0.191	AB: 0.382			A: 0.134	B: 0.211	AB: 0.422		

Comp. = Compost; E.M. = Effective microorganisms; M.A. = Minia Azotein

Table (7): Effect of compost, bio. and / or mineral NPK fertilization on total chlorophylls content (mg / g. f.w.) and Nitrogen % of *lavandula officinalis*, Chaix. during 2011 and 2012 seasons.

bio. and / or mineral NPK fertilization	**Total chlorophylls content (mg / g. F.W.)**									
	First season					Second season				
	Comp. 0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)	Comp.0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)
Control	2.544	2.627	2.735	2.791	2.674	2.560	2.648	2.751	2.805	2.691
100% N (N_3PK)	2.801	2.896	2.989	3.044	2.933	2.840	2.936	3.035	3.104	2.979
75% N (N_2PK)	2.724	2.803	2.893	2.960	2.845	2.764	2.850	2.937	3.013	2.891
50% N (N_1PK)	2.646	2.720	2.818	2.878	2.766	2.669	2.737	2.832	2.911	2.787
E.M.	2.681	2.764	2.848	2.921	2.804	2.709	2.796	2.886	2.961	2.838
E.M.+75%N (N_2PK)	2.821	2.951	3.012	3.069	2.963	2.863	2.948	3.068	3.128	3.002
E.M.+50%N (N_1PK)	2.736	2.808	2.91	2.963	2.854	2.769	2.849	2.956	3.016	2.898
M.A.	2.666	2.744	2.833	2.901	2.786	2.689	2.767	2.864	2.948	2.817
M.A.+75%N (N_2PK)	2.761	2.833	2.949	3.007	2.888	2.803	2.889	3.011	3.058	2.940
M.A.+50%N (N_1PK)	2.707	2.792	2.877	2.945	2.830	2.736	2.829	2.924	2.997	2.872
Mean (B)	2.709	2.794	2.886	2.948		2.740	2.825	2.926	2.994	
L.S.D at 5%	A: 0.012	B: 0.017	AB: 0.034			A: 0.021	B: 0.019	AB: 0.038		
bio. and / or mineral NPK fertilization	Nitrogen %									
	First season					Second season				
	Comp 0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)	Comp.0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)
Control	1.832	1.863	1.884	1.900	1.870	1.903	1.935	1.957	1.974	1.942
100% N (N_3PK)	2.317	2.351	2.376	2.403	2.362	2.400	2.450	2.473	2.502	2.456
75% N (N_2PK)	2.155	2.191	2.220	2.397	2.241	2.245	2.282	2.311	2.488	2.332
50% N (N_1PK)	1.967	2.001	2.027	2.048	2.011	2.046	2.081	2.086	2.128	2.085
E.M.	1.918	1.951	1.965	1.985	1.955	1.995	2.029	2.044	2.065	2.033
E.M.+75%N (N_2PK)	2.304	2.348	2.375	2.401	2.357	2.401	2.447	2.471	2.500	2.455
E.M.+50%N (N_1PK)	2.082	2.119	2.146	2.167	2.129	2.167	2.204	2.229	2.251	2.213
M.A.	1.873	1.904	1.925	1.941	1.911	1.948	1.980	2.002	2.019	2.049
M.A.+75%N (N_2PK)	2.224	2.263	2.291	2.314	2.273	2.318	2.358	2.386	2.408	2.368
M.A.+50%N (N_1PK)	2.022	2.057	2.083	2.106	2.067	2.104	2.140	2.167	2.191	2.151
Mean (B)	2.069	2.105	2.129	2.166		2.153	2.215	2.213	2.253	
L.S.D at 5%	A: 0.031	B: 0.011	AB: 0.022			A: 0.021	B: 0.031	AB: 0.062		

Comp. = Compost; E.M. = Effective microorganisms; M.A. = Minia Azotein

Table (8): Effect of compost, bio. and / or mineral NPK fertilization on phosphorus and Potassium % of *lavandula officinalis,* Chaix. during 2011 and 2012 seasons.

bio. and / or mineral NPK fertilization	**Phosphorus %**									
	First season					Second season				
	Comp. 0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)	Comp.0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)
Control	0.25	0.27	0.29	0.31	0.280	0.40	0.43	0.46	0.49	0.445
100% N (N_3PK)	0.35	0.38	0.38	0.42	0.383	0.48	0.54	0.55	0.63	0.550
75% N (N_2PK)	0.32	0.35	0.36	0.40	0.358	0.48	0.52	0.54	0.59	0.533
50% N (N_1PK)	0.29	0.33	0.35	0.37	0.335	0.45	0.50	0.53	0.53	0.503
E.M.	0.29	0.33	0.35	0.36	0.333	0.44	0.48	0.51	0.53	0.490
E.M.+75%N (N_2PK)	0.34	0.37	0.38	0.41	0.375	0.47	0.53	0.54	0.61	0.538
E.M.+50%N (N_1PK)	0.31	0.35	0.35	0.39	0.350	0.46	0.51	0.52	0.57	0.515
M.A.	0.28	0.31	0.32	0.34	0.313	0.43	0.47	0.50	0.53	0.483
M.A.+75%N (N_2PK)	0.33	0.36	0.37	0.40	0.365	0.48	0.52	0.56	0.60	0.540
M.A.+50%N (N_1PK)	0.30	0.34	0.34	0.38	0.340	0.45	0.50	0.51	0.55	0.503
Mean (B)	0.306	0.339	0.349	0.378		0.454	0.500	0.522	0.563	
L.S.D at 5%	A: 0.021	B: 0.011	AB: N.S			A: 0.021	B: 0.021	AB: N.S		
bio. and / or mineral NPK fertilization	Potassium %									
	First season					Second season				
	Comp. 0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)	Comp.0%	Comp.10%	Comp.20%	Comp.30%	Mean (A)
Control	1.781	1.811	1.831	1.846	1.817	1.821	1.852	1.873	1.890	1.859
100% N (N_3PK)	2.126	2.165	2.194	2.218	2.176	2.182	2.225	2.255	2.277	2.235
75% N (N_2PK)	1.982	2.018	2.044	2.065	2.027	2.048	2.085	2.112	2.124	2.092
50% N (N_1PK)	1.856	1.889	1.912	1.930	1.897	1.907	1.941	1.965	1.984	1.949
E.M.	1.827	1.859	1.871	1.888	1.861	1.874	1.907	1.920	1.938	1.910
E.M.+75%N (N_2PK)	2.113	2.151	2.179	2.202	2.161	2.183	2.222	2.252	2.275	2.233
E.M.+50%N (N_1PK)	1.931	1.966	1.991	2.011	1.975	2.002	2.028	2.054	2.075	2.040
M.A.	1.802	1.832	1.852	1.867	1.838	1.847	1.878	1.899	1.915	1.885
M.A.+75%N (N_2PK)	2.043	2.080	2.107	2.129	2.090	2.110	2.148	2.174	2.199	2.158
M.A.+50%N (N_1PK)	1.891	1.925	1.949	1.968	1.933	1.947	1.982	2.007	2.027	1.991
Mean (B)	1.935	1.970	1.993	2.012		1.992	2.027	2.051	2.070	
L.S.D at 5%	A: 0.011	B: 0.011	AB: 0.022			A: 0.011	B: 0.011	AB: N.S		

Comp. = Compost; E.M. = Effective microorganisms; M.A. = Minia Azotein

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الملخص العربي
تأثيرالكمبوست والأسمدة الحيوية / المعدنية على نباتات اللافندر

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تم اجراء البحث خلال موسمى 2011 ، 2012 بمشتل نباتات الزينه – كلية الزراعة – جامعة المنيا لدراسة تأثير الكمبوست ومعاملات التسميد الحيوى والمعدنى أو كلاهما معا على محصول العشب والزيت الطيار لنباتات اللافندر.

وقد اظهرت النتائج أن الوزن الطازج والجاف للعشب للنبات / الحشة أو للنبات / الموسم وكذلك الزيت الطيار (النسبة المئوبة ومحصول الزيت للنبات / حشة ومحصول الزيت للنبات / الموسم) والمكونات الكيمائية (الكلوروفيلات الكلية والنسبة المئوية لعناصر النتروجين والفوسفور والبوتاسيوم) زادت معنويا نتيجة استعمال كل مستويات الكمبوست. وكانت أعلى القيم قد سجلت نتيجة استعمال المستوى العالى من الكمبوست (30 %).وقد سجلت النتائج زيادة معنوية فى الوزن الطازج والجاف (فى الحشتين ومحصول العشب للنبات / الموسم) وانتاجية الزيت والتقديرات الكيماوية نتيجة استعمال معاملات التسميد الحيوى والكيماوى أو كلاهما معا وكانت أكثرها كفاءة هى معاملات E.M + 75 % ن والتسميد المعدنى ن (جرعة كاملة).

يمكن التوصية بامداد نباتات اللافندر بالكمبوست (30 % بالحجم) مع .E.M + 75 % ن أو مع 100 % ن وذلك للحصول على أعلى انتاج من العشب والزيت الطيار والمكونات الكيمائية للنباتات المزروعة فى أرض رملية.