Effect of Mineral, Organic and Bio- Fertilization on Yield and Quality of Parsley (*Petroselluinam sativam*, L.)

[*]Radwan, F. I .,[*] A. I. Abido,[**] E. H. Shaben and Drakhshan I. saeed*
* plant production Dept., Fac. Agric. (Saba Basha) Alexandria University, Egypt
** Medicinal and Aromatic Res. Dept, A. R. C. Alexandria, Egypt, Div. of Medicinal and Aromatic plants

ABSTRACT : 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 the seasons of 2012/2013 and 2013/2014 to study the effect of NPK fertilizers, organic manure levels and biofertilizers on the growth parameters, chemical composition, and majors compounds of the essential oil of Parsley (*Petroselinum sativum*, L.). The applied experimental design was randomize complete blocks design with three replicates. The main results could be summarized as follows: (1) The fertilization treatments differently affected the mean values of all studied characters, (2) The application with organic manure (2 ton)/fed + 50% NPK+ Cerealine + phoshorein and organic manure (4 ton)/fed + 50% NPK + Cerealine + phosphorein significantly increased plant height, leaf area index, fresh and dry weight at two cuts as well as chlorophyll a & b, chemical composition (N, P and K%) and Vitamin C content during both seasons. (3) However, the application organic manure 2 ton org/fed + 75% NPK + phosphorein gave the highest of major's compounds (apiol, myristien, B- pinene and B- phellandrene %) during 2012/2013 season. This investigation suggests the need for more studies concerning the effect of NPK fertilizer organic manure and biofertilization on Parsley plant under different environments using different types of soil to reach the optimum combination to achive the best yield.

Key words: Mineral, Organic, biofertilization, Parsley**,** major's compounds oil.

INTRODUCTION

Petroslinum sativum Mill (parsley) Fam. *Apiaceae* is a widely cultivated herb used extensively for garnishing and seasoning foods, and for production of an essential oil. Fresh parsley is one of the most popular green herbs. The mature seed is steam distilled to produce parsley seed's, oil and parsley herb oil comes from the plant bearing immature seeds. Parsley herb oil has flavor more like the fresh leaves and is in greater demand than seed oil, which is often distilled from aged seed of low germinability (Simon *et al.,* 1984). The root may, also, be harvested for use as a medicinal herb. Parsley combines well with most foods except sweets. It has a mild taste blends other flavors together, and has a high nutrient's content and used in medicinal, household cosmetic and fragrance (Rashed, 2002).

Fertilization is one of the most important factors limiting the productivity of plants. The intensive use of expensive mineral fertilizers in recent gears results in environmental pollution problems. However, Chemical fertilizers at extremely high rates for along period decreased the potential activity of microflora and the stability of soil organic matter (Hussien, 1995). Additionally, organic manures are in the form of compost, animals manure, 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 acid, organic acids, sugars and organic matter (Abou El- Fadl *et al*., 1968). Furthermore, biofertilization is an important factor being used to produce products without some mineral fertilizer that cause environmental pollution problems, and high

rates of it leads to decrease the potential activity of microflora and the mobility of organic matters. Hence, the attention has been focused on the researches of bio- fertilization to safe alternative to specific chemical fertilizers. Biofertilizers play vital role for increasing the number of microorganisms and accelerate certain microbial process in the rhizosphere of inoculated soil of plants which can change the available forms of some nutrients tobe plants (Kandeel *et al*., 2001, Rashed, 2002; Mohamed and Abdu, 2004).

This research, however, is an attempt to find out the best fertilization treatments (chemical fertilizer, organic manure and biofertilizer) on the vegetative growth and chemical composition of psarley (*Petroselinum sativum*, Mill).

MATERIALS AND METHODS

Two filed experiments were carried out at the Experimental Farm of Faculty of Agric. (Saba Basha) Alexandria University, at Abees region, Alexandria, Egypt, during, the two growing seasons of 2012/2013 and 2013/2014 to study the effect of fertilization treatments (chemical fertilizer, organic manure and bio- fertilization) on growth and chemical composition of parsley(*Petroselinum sativum* Mill) plants. The experimental design was a complete randomized block design with three replicates.

The parsley seeds were sown on November 11^{th} and 14^{th} in the two growing seasons, respectively. The plots area of each was 4 square meters (2.0m ×2.0m) with 3 rows, the distance between the rows was 50 cm and 10 cm between plants.

The chemical fertilizers were applied as ammonium sulphate (20.5%N), calcium superphosphate (15.5% P_2O_5) and potassium sulphate (48% K_2O) at the rates of (100, 100 and 50 kg/fed, respectively) which are the recommended dose.

The used biofertilization of bacteria were phosphorein (*Bacillusmegatheruim phosphorus* dissolving bacteria P.D.B.), cerealine *(Azospirillum Lipoferum* and *Azotobacter chroococcum*) which supplied by National Research Center. The inoculation, with phosphorein and cerealine was preformed by coating parsley seed with each product individually using a sticking substance (Arbic gum at 5%) just before sowing.

The organic fertilization (Sheap manure) was carried at the rates of 2 and 4 tons/fed, which were applied through the soil preparation before sowing.

The recommended dose of NPK was divided in two equal parts, the first one was applied one month after sowing and the second one was applied after the first cut.

The tested treatments were conducted as follows:
F_1: 100% NPK (control).
F_2: 75% NPK + cerealine.

F_3: 50% NPK + cerealine + phosphorein.
F_4: Organic manure (2 ton/fed) + 75% NPK.
F_5: Organic manure (2 ton/fed) + 75% NPK + cerealine.
F_6: Organic manure (2 ton/fed) + 75% NPK + phosphorein.
F_7: Organic manure (2 ton/fed) + 50% NPK + cerealine+ phosphorein.
F_8: Organic manure (4 ton/fed) + 75% NPK.
F_9: Organic manure (4 ton/fed) + 75% NPK + cerealine.
F_{10}: Organic manure (4 ton/fed) + 75% NPK + phosphorein.
F_{11}: Organic manure (4 ton/fed) + 50% NPK + cerealine+ phosphorein.

The physical and chemical characteristics of the experimental soil and used sheep manure composition are given in Tables (1) and (2). The soil was ananlyzed according to be methods deseribed by Page *et al*. (1982)

Table (1): The physical and chemical properties of the experimental soil in 2012/2013 and 2013/2014 seasons

Soil properties	Values	
	2012/2013	2013/2014
A- Particle size distribution (%)		
Sand	15.00	14.80
Silt	42.00	42.20
Clay	43.00	43.00
Soil texture	Clay loam	Clay loam
B- Chemical properties		
pH (1:1)	7.90	7.80
EC (1:1) dS/m	2.20	2.10
1- Soluble cations (1:2) (Cmol/kg soil)		
K^+	0.90	0.95
Ca^{++}	4.15	4.20
Mg^{++}	3.10	3.15
Na^{++}	8.10	8.20
2- Soluble anions (1:2) (Cmol/kg soil)		
CO^-_3+ HCO^-_3	2.70	2.60
CL^-	11.50	11.70
SO^-_4	0.50	0.48
Calcium carbonate, %	7.70	7.80
Organic matter, %	1.00	0.90
Total nitrogen, %	0.45	0.47
Avaliable Phosphorus (mg/kg)	3.70	3.80
Avaliable K (mg/kg)	162.3	170.1

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	7.5
O.M (%)	23.20
O.C (%)	21.00
Total (N%)	2.20
Total (P%)	1.15
Total (K%)	1.45
C/N ratio	11.5:1

At harvest dates on January 7th and February 6th in the two season, 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 (g).
3. Leaf area index (cm^2).
4. Chlorophyll (a and b), mg/g fresh weight were determined in fresh leaves samples of the fifth leaf from top at harvest and after 30 days for parsley, using the method by Moran (1982).
5. The N, P and K contents were determined in the acid digested solution which was prepared according to Hach *et al.* (1985) using a mixture of hydrogen peroxide and sulfuric acid (4:10).

- Elements extraction was made on a known weight of the dried samples (0.2 mg).
- Nitrogen was determined using the microkjeladhl method according to Black (1983).
- Phosphorus was determined colorimetrically using the method described by Jackson (1967) and Potassium was estimated using flame photometer method according to Richards (1954).

1. Vitamin (C) content was determined in filtered juice samples and expressed as (mg) ascorbic acid/100 ml fresh juice as described by (A.O.A.C., 1965).
2. The percentage of major constituents (Apiole, myristiein, ß- pinene, and ß- phellandrene) were estimated by measuring the peak area of the different compounds of the chromatogram according to Heftman (1967) and Gunther and Joseph (1978).

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

RESULTS AND DISCUSSION

A- Growth parameters and yield:

The obtained results, given in Tables (3 and 4) cleared, that fertilizer treatments exhibited a significant effect on all estimated traits in both seasons.

Application of (F_6) treatment organic manure (2 ton)/fed + 50% NPK + cerealine + phosphorein and (F_{11}) organic manure (4 ton)/fed + 50% NPK + cerealine + phosphorin significantly, increased plant height, leaf area index, fresh and (g), dry weight (g) at two cuts as well chlorophyll a, b in both seasons. It could be concluded that this positive effect on growth characters and chlorophyll a, b in response to sheep manure levels, may be attributed to increasing maentration in plant tissues (Opera and Asigebu 1996). Also, the phosphate solubilizing bacteria (phasphorein) and nitrogen fixing (cerealine) may increase the synthesis of endogenous phytothormones 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 Rashed (2002) on parsley, Gad (2001) on *Anelthum graveolens*; Mohammad *et al*. (2012) on *pimpinella anisum*; Abdel- Latif. (2002) on *Caruim carvi* and Kandeel *et al.* (2001) and Mohamed and Abdu (2004) on *Foeniculum vulgare*.

B- Chemical composition and vitamin (C):

The data in Table (4) showed that all treatments of fertilization, affected chemical composition (N, P and K%) and vitamin, (C) content in both seasons. It is clear from data that the highest mean values of chemical composition (N, P and K%) and vitamin (C) content, resulted from the treatments of (F_7) 2 ton organic manure/fed + 50% NPK + cerealine + phosphorein and (F_{11}) 4 ton/fed organic manure + 50% NPK + cerealine+ phosphorein in both seasons.

The increment of chemical composition (N, P and K%) and vitamin (C) content of plant's leaves using the treatments of organic manure and half dose of NPK and biofertilization; may be attributed to increase in the occupancy root zone of plant as a results of adding fertilization treatments which reflected on nutrients 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 *Petroselinium sativum*, Likwise the results showed significant differences for organic manure + biofertilization in the both seasons, which gave the greatest values for all chemical composition.

C- Major components percentage of essential oil:

The effect of fertilization treatments on essential oil majors compounds (Apiol, Myristien, ß. Pinene and ß- Phellandrene) percentages are shown in Table (5). The results indicated that using fertilization treatments had significant effect on the studied majors compounds percentage of parsley oil. The application of 2 tons organic manure fed + 75% NPK + phosphorein; gave the highest percentage of majors compounds in 2012/2013 season. Similar results were reported by Darzi *et al* (2011) on anisum and Ismail *et al*. (2009) on majoram plant.

Table (3) : Effect of fertilization treatments on vegetative growth at two cut during 2012/2013 and 2013/2014 seasons

Treatments	Plant height (cm)				Leaf area index (cm^2)				Fresh weight (g)			
	2012/2013		2013/2014		2012/2013		2013/2014		2012/2013		2013/2014	
	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
F_1: NPK (control)	27.23c	27.67d	25.00d	27.23ed	5.20c	3.71c	4.90b	2.98c	138.33i	124.00d	130e	140c
F_2: 75% NPK + Cerealine	24.23g	25.17g	24.67d	24.53g	5.40c	3.90b	4.95b	3.38b	163.33e	150.00b	190.5b	150b
F_3:50%NPK+Cerealine+ phosphorein.	27.17c	25.17g	24.67d	27.17d	5.81b	4.40b	5.10b	3.50b	198.33d	130.00c	170c	153b
F4: organic manure (2ton/fed) + 75% NPK	27.47b	26.17f	24.33e	27.73c	4.67d	3.10d	4.70c	3.17b	125.00b	110.00e	160cd	146c
F_5: organic manure (2ton/fed)+75% NPK+ cerealine	27.64b	28.17c	27.83b	26.77e	4.70d	3.15d	4.55c	3.20b	216.67cb	140.00b	190c	154b
F_6: organic anure(2ton/fed)+75%NPK+ phosphorein	26.37d	28.83b	27.33b	27.37cd	5.21b	4.30b	5.15b	3.45b	211.67c	150.00b	180c	144c
F_7: organic anure(2ton/fed)+50%NPK+ Cerealine+ phosphorein	28.77a	2967a	29.44a	28.97a	5.20a	5.00a	5.50a	4.10a	231.67a	161.16a	215a	165a
F_8: organic manure (4ton/fed)+75%NPK	25.73f	26.33f	25.83c	25.73f	5.75b	4.15b	5.11b	3.36b	156.67g	115.00de	155d	144c
F_9:Org.(4ton/fed)+75%NPK+ Cerealine	26.07e	26.83e	25.33c	26.07f	5.80b	4.20b	5.16b	3.26b	185.00d	135.c	195b	155b
F_{10}: organic manur(4ton/fed)+75%NPK+ phosphorein	23.30h	28.83b	24.67d	24.30g	5.90b	4.18b	5.10b	3.30b	195.33d	137.00c	155d	148b
F_{11}: organic manur(4ton/fed)+50%NPK+ Cerealine+phosphorein	28.90a	35.00a	30.00a	29.63a	6.00a	5.01a	5.51a	4.11a	225.33a	156.00a	170c	165a
L.S.D. (0.05)	0.25	0.30	0.40	0.45	0.35	0.40	0.30	0.40	10.30	9.10	9.30	8.90

***** Means followed by the same letter (s) in each column are not significantly different at 0.05 level of probability.

Table (3) : Cont'd.

Treatments	Dry weight (g)				Chlorophyll (mg/g)			
	2012/2013		2013/2014		2012/2013		2013/2014	
	1st cut	2nd cut	1st cut	2nd cut	a	b	a	b
F_1: NPK + control	45.77e	38.38g	30.40f	34.70h	1.60d	0.39d	1.58d	0.48b
F_2: 75% NPK + Cerealine	46.53d	41.20c	55.60b	44.15b	1.62c	0.31e	1.51f	0.33d
F_3:50%NPK+Cerealine+ phosphorein.	42.07g	39.80d	50.70c	35.90g	1.65c	0.39d	1.55e	0.36c
F4: organic manure (2ton/fed) + 75% NPK	55.83b	40.15d	51.8c	52.60c	1.70bc	0.40d	1.60d	0.39c
F_5: organic manure (2ton/fed)+75% NPK+ Cerealine	52.80b	41.20c	35.70g	36.70f	1.75bc	0.50b	1.58d	0.48b
F_6: organic manure (2ton/fed)+75%NPK+ phosphorein	56.33b	40.60c	40.70e	38.90e	1.74bc	0.52b	1.55e	0.49b
F_7: organic manure (2ton/fed)+50%NPK+ Cerealine+ phosphorein	62.80a	53.38a	71.20a	54.41a	2.18a	0.60a	1.90a	0.62a
F_8: organic manure (4ton/fed)+75%NPK	42.43g	36.30f	42.60d	40.60d	1.74bc	0.42d	1.66c	0.52b
F_9:Org.(4ton/fed)+75%NPK+ Cerealine	56.73b	41.70c	35.40g	36.40f	1.78b	0.46c	1.72b	0.48b
F_{10}: organic manure (4ton/fed)+75%NPK+ phosphorein	49.47c	37.40	34.70g	33.90i	1.72bc	0.40d	1.68c	0.50b
F_{11}: organic manure (4ton/fed)+50%NPK+ cerealine+phosphorein	62.07a	54.20a	71.70a	54.15a	2.20a	0.16a	1.92a	0.63a
L.S.D. (0.05)	1.20	1.00	1.20	1.00	0.10	0.03	0.03	0.03

***** Means followed by the same letter (s) in each column are not significantly different at 0.05 level of probability.

Table (4) : Chemical composition (N, P and K percentages) and vitamin (C) as influenced by fertilization treatments during 2013 and 2014 seasons

Treatments	N%		P%		K%		Vitamin (C) Mg/100ml fresh Juice	
	2013	2014	2013	2014	2013	2014	2013	2014
F_1: NPK (control)	2.60d	2.75d	0.590.gh	0.602ef	2.37e	2.45e	107.08p	109.30f
F_2: 75% NPK + Cerealine	2.75cd	3.10c	0.600eg	0.617d	2.58d	2.50e	109.10eb	110.20ef
F_3:50%NPK+Cerealine+ phosphorein.	2.77cd	3.20c	0.595f	0.605e	2.60d	2.65d	109.50e	110.70def
F4: organic manure (2ton/fed) + 75% NPK	2.56e	2.90d	0.585h	0.595f	2.67d	2.70d	110.30de	111.40cde
F_5: organic manure (2ton/fed)+75% NPK+ Cerealine	2.80bcd	2.30c	0.610de	0.622d	2.81c	2.85c	111.70de	112.20cde
F_6: organic manure (2ton/fed)+75%NPK+ phosphorein	3.10b	3.60b	0.635b	0.650b	2.87bc	2.90c	112.30d	112.80cd
F_7: organic manure (2ton/fed)+50%NPK+ Cerealine+ phosphorein	3.50g	4.20a	0.660a	0.670a	3.35a	3.50a	130.40a	135.40a
F_8: organic manure (4ton/fed)+75%NPK	2.85bc	3.50b	0.620cd	0.635c	2.67d	2.70d	112.90d	113.40c
F_9:Org.(4ton/fed)+75%NPK+ Cerealine	2.90bc	3.50b	0.590gh	0.604ef	2.96b	3.20b	117.90c	120.50b
F_{10}: organic manure (4ton/fed)+75%NPK+ hosphorein	3.00b	3.70b	0.630bc	0.650b	2.97b	3.20b	120.30b	122.40b
F_{11}: organic manure (4ton/fed)+50%NPK+ Cerealine+phosphorein	3.90a	3.30a	0.670a	0.680a	3.40a	3.55a	132.70a	136.30a
L.S.D. (0.05)	0.20	0.25	0.012	0.010	0.015	0.012	2.40	2.30

***** Means followed by the same letter (s) in each column are not significantly different at 0.05 level of probability.

Table (5): Effect of fertilization treatments on major components (%) in Parsely oil of second season (2013/2014)

Treatments	Apiol (%)	Myristicin (%)	B- Pinene (%)	B- Phellandrene (%)
F_1: NPK + control	17.2e	31.5d	12.5g	5.1cb
F_2: 75% NPK + Cerealine	17.5de	32.4c	12.3g	5.3b
F_3:50%NPK+Cerealine+ phosphorein.	17.4de	33.2c	14.1c	5.3b
F4: organic manure (2ton/fed) + 75% NPK	17.9c	33.4c	14.2c	5.8e
F_5: organic manure (2ton/fed)+75% NPK+ Cerealine	18.3b	34.2b	14.8b	5.9a
F_6: organic manure (2ton/fed)+75%NPK+ phosphorein	18.8a	35.3a	15.1a	6.00a
F_7: organic manure (2ton/fed)+50%NPK+ Cerealine+ phosphorein	18.4b	35.3a	13.7d	5.9a
F_8: organic manure (4ton/fed)+75%NPK	17.9c	34.2b	12.8f	5.2b
F_9:Org.(4ton/fed)+75%NPK+ Cerealine	17.2e	34.3b	12.7f	5.4b
F_{10}: organic manure (4ton/fed)+75%NPK+ phosphorein	17.3e	33.5c	12.7f	5.1cb
F_{11}: organic manure (4ton/fed)+50%NPK+ Cerealine+phosphorein	17.3	33.6c	13.2e	5.1cb
L.S.D. (0.05)	0.35	0.42	0.30	0.25

***** Means followed by the same letter (s) in each column are not significantly different at 0.05 level of probability.

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الملخص العربي

تأثير التسميد المعدني والعضوي والحيوي على محصول وجودة البقدونس

[*]فتحي إبراهيم رضوان . [*]على إبراهيم على عبيدو . [**]السيد حسن شعبان

[*]درخشان اسماعيل سعيد

* قسم الإنتاج النباتي . كلية الزراعة سابا باشا . جامعة الإسكندرية . مصر

* قسم بحوث النباتات الطبية والعطرية – مركز البحوث الزراعية – شعبة إنتاج وتكنولوجيا النباتات الطبية والعطرية.

أجريت تجربتان حقليتان خلال موسمي الزراعة 2013/2012 ، 2014/2013 لدراسة تأثير التسميد الكيماوي ومعدلات السماد العضوي والحيوي على صفات النمو الخضري الحيوي الكيماوي ومكونات محتوي الزيت لنبات البقدونس وقد استخدم في هذه التجارب التصميم الإحصائي القطاعات العشوائية الكاملة لثلاث مكررات.

ويمكن تلخيص أهم النتائج فيما يلي:

– أدى استخدام معاملات التسميد لتأثيرات معنوية مختلفة على أعلى متوسط لقيم جميع الصفات المدروسة أيضاً.

– أدى إضافة المعاملة (7) 2 طن سماد عضوي/فدان + 50% نتروجين فوسفور بوتاسيوم + سيريالين + فوسفورين إلى زيادة معنوية لارتفاع النبات، دليل المساحة الورقية، الوزن الطازج والجاف عند حشتين بالإضافة إلى كلوروفيل أ، ب والمكونات الكيميائية (نتروجين، فوسفور، بوتاسيوم%) محتوي وفيتامين سي.

– أيضا أدى إضافة المعاملة (6) 2 طن سماد عضوي/فدان + 75% نتروجين فوسفور وبوتاسيوم + فوسفورين إلى ارتفاع مكونات محتوى الزيت (النسبة المئوية للمكونات) في الموسم الأول 2013/2012.

نوصي باستخدام 2 طن سماد عضوي /ف + 50 + 50+ 25ك/ف من سلفات النشادر وسوبر فوسفات الكالسيوم وسلفات البوتاسيوم على التوالي + سيريالين + فوسفورين للحصول على أفضل نمو وجودة نبات البقدونس.