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EVALUATION OF SOME VARIETIES OF *Ocimum basilicum* L. AND THEIR RESPONSE TO SOME ORGANIC MANURES

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ABSTRACT

Among medicinal plants, basil is cultivated in Egypt, and has a high economic value. The cultivated area of sweet basil in Mediterranean countries has expanded markedly in recent years due to increasing demand of the European market.

Two field experiments were conducted at Experimental Station of the Medicinal and Aromatic Plants, Fac. Agric., Mansoura Univ. during two successive summer seasons of 2004 and 2005 to investigate the effect of two organic manure sources and levels; cattle manure (15, 30 and 45m^3/fed) and chicken manure (10, 20 and 30m^3/fed) on growth, volatile oil content and compositions. Five Ocimum genotypes were used i.e. Bush basil "Minimum", Sweet basil, Lettuce-leaf basil "Crispum", Purple Ruffles basil (local variety) and Genovese basil (Germany variety).

The obtained results indicated that, application of cattle and chicken manure gave significant differences in plant height, number of branches, herb fresh and dry weights per plant, as well as the herb yield per plant. The highest values were obtained for the plants treated with the highest level of cattle manure (45 m^3 / fed) and chicken manure (30 m^3 / fed) at two cuts in both seasons. Volatile oil percentage was significantly affected, approximately by all organic manure sources. The volatile oil often contains monoterpenes such as linalool, methyl chavicol and ocimene. Volatile oil composition varied with plant species and plant fertilization. Treating plants with all levels of organic manure caused an increase in the chlorophyll content, N, P and K percentages during the two seasons. Application of cattle manure led to increase basil plant growth, herb and oil yield over with control treatment. Application of chicken manure was the superior treatment to enhance all growth parameters in both seasons. Also, it is evident that the application of treatments improved the growth of plants.

Sweet basil variety was the best genotype in terms of dry herb and volatile oil yield production, and with different organic fertilizers levels exerted significant differences in the growth characters, as herb fresh and dry weight / plant, volatile oil, linalool percentage (the main compound), chlorophyll content and N (%). Purple Ruffle variety presented consequently the highest lodging tendency; expressed as plant height, number of branches per plant and methyl chavicol percentage (the main compound).

INTRODUCTION

Basil is a very important member of Fam. *Lamiaceae* (*Labiatae*). It is enjoyed for its rich and spicy, mildly peppery flavor with a trace of mint and clove. Like others plants in this family, basil can be identified as an annual herb by its square, hairy stem, up to 50 cm high. There are over 40 known varieties of basil. It is a well-known fact that the species basilicum is responsible for the very great number of subspecies, varieties and forms, of which *Ocimum basilicum* or sweet basil is the most commonly known and grown (Vina and Murillo, 2003).

Basil is truely an incredible herb, used fresh or dried for flavoring and is cultivated in many countries. It is produced commercially in Egypt, India, France, Hungary, Israel, Indonesia and the United States (Flavin, 1987).

Traditionally, basil is a source of essential oils and aroma compounds, a culinary herb and an attractive fragrant ornamental. Plant extractions are used in folk medicine, and have been shown to contain a biological activity as an insecticidal and antimicrobial (Sammbamurty and Subrahamanyan, 2000). Medicinally, basil is useful in treatment of headaches, coughs. It is also thought to be carminative, stimulant, and antispasmodic, antidepressant, antiseptic and insect repellent. Basil is one of many healing herbs containing both anti-cancer and anti-oxidant substances (Bhattacharje, 1998).

Basil is well known for its numerous economical, medicinal and aromatic values; the importance of basil is increasing and has undoubtedly a promising future in Egypt for the economic revenue and foreign currency.

Basil needs a richer soil, more fertilizer than most herbs and seem to thrive when well-rotted manure and incorporated compost before planting or top dress at planting to keep the plants producing all season (Blank *et al*., 2004). Organic fertilizers are added to soils in different areas in the world extensively. Their beneficial effects are known long time ago (Rizk *et al*.,1971).

The organic manure is known to improve the properties of soil by increasing the limited moisture holding capacity (Maynard, 1994). In addition, it can change the chemical properties of soil through lowering pH and increasing C/ N ratio, cation exchange capacity and ion uptake (Bvoungyeul *et al*., 1996).

Application of organic manure increased the soil fertility through increasing the soil acidity due to formation of CO_2 and other organic acids. Also, the organic manure plays a key role in the behavior of micronutrients in the soil. Both soluble and insoluble complexes are formed substantial evidence which play a prominent role in the dissolution of micronutrients and their transport to plant roots, where they not only help in increasing and stabilizing soil fertility, but also improve the chemical, physical and biological characteristics of the soil (El-Shafie and El- Shikha, 2003).

Application of organic matter provides many essential nutrients needed by crop plants. The increase in crop yield by the use of animal manure have been imperative many time as resulted, mainly, from the nitrogen, phosphorus or potassium or the combination of the three elements supplemented by manure (Parker and Summers, 1983).

It is well known that using higher amounts of mineral fertilizer cause their in the ground and humans. On the other hand, Organic manures are valuable as a source of fertilizers, and essential macro and micronutrients to plants, and serves as a good natural soil texture conditioner being rich in organic matter (Mishref *et al*., 2000).

Many investigators reported that adding organic manures as fertilizer led to stimulate biodegradation through increasing the population and activities of micro-organisms in the soil and minimizing the less of nutrients by leaching. Moreover, Jacoub (1999) investigated the effect of some organic manures and inorganic fertilization (NPK) on growth, yield and chemical composition of

sweet basil and thyme plants. He reported that NPK and organic manures increased plant height, number of branches, herb fresh and dry weights per plant, oil percentage and oil yield per plant. Also, NPK and organic manures increased chlorophyll content in leaves, N, P and K in basil and thyme herbs. It was also found that the treatments increased p-cymene, thymol and carvacrol percentage in thyme. Abd El-Raouf (2001) reported that increasing organic manure rates from 35 to 55 m^3 / fed significantly increased the growth characters of basil (plant height, number of branches, herb fresh and dry weights) in addition to oil content. On the other hand, Aboud *et al*. (2006) mentioned that, from the practical point of view, the increase in herb biomass and oil yield, induced by organic fertilization types can has positive effects, since, the commercial value of basil and its farmers incomes also depends on the amount of essential oil production.

In the present work, the principal aim is to investigate the improvement of growth and oil yield of five varieties of basil (*Ocimum basilicum* L.) plant; i.e., Bush basil "Minimum", Sweet basil, Lettuce-leaf basil "Crispum", Purple Ruffles basil (local variety) and Genovese basil (Germany variety) under different organic manure types.

MATEIRALS AND MOTHEDS

The present study was carried out at Experimental Station of the Medicinal and Aromatic Plants, Fac. Agric., Mansoura Univ. during two successive summer seasons of 2004 and 2005 for evaluating five genotypes of basil (*Ocimum basilicum* L.) plant, and to study the effect of two kinds with different levels of organic manure, namely cattle manure and chicken manure on growth, volatile oil content and their chemical composition. These genotypes were Bush basil "Minimum", Sweet basil, Lettuce-leaf basil "Crispum", Purple Ruffles basil (local variety) and Genovese basil (Germany variety).

Seeds of the four genotypes were selected from the base population of the previous generations (2003 and 2004), and the fifth genotype was obtained from Műggenburg Firm, Hamburg, Germany.

The all five genotypes were sown in beds on March 10^{th} and 14^{th} for the first and second seasons (2004 & 2005), respectively. After 35 days from planting, seedlings were transplanted to field in both generations into plots; the plot area was 1.5x3 m containing five ridges. Every ridge was 1.5 m containing 5 plants at a distance of 30 cm between plants (25 plants per plot) and the distance was 60 cm between ridges.

The experiment included seven treatments for each variety as follows:

1- Control (without organic manure)
2- Cattle manure at 15 m^3 / fed
3- Cattle manure at 30 m^3 / fed
4- Cattle manure at 45 m^3 / fed
5- Chicken manure at 10 m^3 / fed
6- Chicken manure at 20 m^3 / fed
7- Chicken manure at 30 m^3 / fed

The previous treatments were arranged in four replicates using the completely randomized block design. The cattle and chicken manure were added during soil preparation. The two organic manures; cattle and chicken manure were composted for three months before applying. During composting period manures were moistened and mixed every two weeks. The source of cattle manure (CM) and chicken manure (CKM) were from cattle and poultry farm Fac. Agric. Mansoura Univ. The analyses of the used cattle and chicken manure are shown in Table (A).

Table (A): Chemical analyses of organic manure sources

Organic manure / Character	Cattle manure		Chicken manure	
	1st season	2nd season	1st season	2nd season
Moisture content (%)	5.82	4.97	3.98	4.25
Organic carbon (%)	24.32	23.65	25.65	28.65
Organic matter (%)	35.46	32.46	36.05	38.21
pH	7.1	7.2	7.5	7.3
C / N	18.32:1	17.65:1	15.12:1	10.32:1
N (%)	1.24	1.39	1.65	1.89
P (%)	0.65	0.54	4.25	3.98
K (%)	2.43	2.02	5.32	6.54
Cn (ppm)	38	43	68	74
Zn (ppm)	103	92	189	225
Mn (ppm)	98	125	258	236
Fe (ppm)	1248	924	1897	2058

Two cuts were taken, the first one was on July 10th and the second cut was done on September 10th in both seasons. The plants were cut at 10 cm above the ground surface in both seasons, and the different growth parameters were recorded.

The volatile oil percentage of herb at every cut was estimated according to Egyptian Pharmacopoeia (1984). Gas liquid Chromatography (GLC) was also a used on some oil samples during the first cut of the second season in the Medicinal and Aromatic Plants Section, El-Dokki, Agricultural Research Center, Cairo Egypt. The components of basil oil were determined according to Hoffman (1967). Chlorophyll content was determined in fresh leaves samples (mg / 100 g) according to Wettstein (1957). The herb at cutting date was dried in an electric oven at 70°C for 24 hours according to A.O.A.C. (1970), then finely ground for chemical determination of the macro-elements (N, P and K). Nutrients content in dry plant herb was determined after wet digestion as follows: Nitrogen % was carried out using micro-kjeldhl method according to A.O.A.C. (1990). Phosphorus % and Potassium % were determined using a method mentioned by Chapman and Pratt (1987). Physical and chemical properties of the experimental soil are presented in Table (B).

Table (B): Physical and chemical properties of the experimental soil in the two seasons of 2004 and 2005.

Soil texture	Clay (%)	Silt (%)	Sand (%)	Organic Matter (%)	pH	Available nutrients (ppm)					
						N	P	K	Zn	Fe	Mn
Clay loam	40.7	33.2	26.1	2.14	8.15	48.9	12.5	358	1.42	8.35	12.2
	40.4	33.6	25.3	2.23	8.12	52.6	14.2	386	1.35	7.79	12.3

All obtained data were subjected to the statistical analysis of variance (ANOVA). The least significant difference (LSD) test was used for comparing of means between treatments as mentioned by Gomez and Gomez (1984).

RESULTS AND DISCUSSIONS

1- Plant height

Data in Table (1) showed that application of cattle manure at 45 m^3 / fed significantly increased plant height of the studied basil varieties in the two cuts of the two growing seasons. In this respect, the highest values were obtained from Purple Ruffles basil and Sweet basil varieties in the two seasons, respectively.

Results showed that increasing chicken manure rates resulted in gradual increments in plant height from the same tested varieties. The increments of plant growth as a result of application of chicken manure may be due to the high contents of N and its effect on soil properties which improved the physiochemical and biological properties (El-Shafie and El-Shikha, 2003). Similar results were found by Hammam (1996) on *Pimpinella anisum* L. who demonstrated that farmyard manure at 40 m^3 / fed significantly increased stem length. Also, El-Kassas (1999) on fennel, Abd El-Raouf (2001) on *Ocimum basilicum* L. and El-Ghawwas *et al*. (2002) on *Nigella sativa* L. found that the plant height was increased when different organic manures were used.

2- Number of branches / plant

Data shown in Table (2) cleared that the different kinds of organic manure gave significant differences in number of branches / plant. Data showed that, the highest level of cattle manure (45 m^3 / fed) gave the highest number of branches / plant of the studied basil varieties. Also, application of chicken manure (30 m^3 / fed) showed significant differences in branches number. In this respect, the highest number of branches / plant was obtained from Genovese and Bush basil varieties respectively, in two cuts of the two growing seasons. The obtained results agreed with those by El-Ghadban (1999) on spearmint and marjoram, Jacoub (1999) and Abd El-Raouf (2001) on sweet basil, who found that different treatments of organic fertilization increased number of branches per plant compared with control. Bhaskar *et al*. (2001) suggested that the application of farmyard manure produced significantly higher number of geranium shoots.

Table (1): Effect of some organic manure levels on plant height (cm) for five varieties in two cuts during the two seasons of basil 2004 /2005

Varieties		Bush basil		Sweet basil		Lettuce-leaf basil		Purple Ruffles basil		Genovese basil	
Treatments (m^3 / fed)		1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut
First season											
Control		40.2	49.5	51.3	54.3	40.3	42.4	58.8	53.3	39.5	39.8
Cattle manure	15	42.5	50.9	54.3	59.8	43.6	45.6	59.8	56.8	45.8	42.8
	30	45.6	55.6	59.5	61.5	49.5	47.3	62.3	60.8	49.5	46.8
	45	50.5	60.2	60.5	63.3	50.2	49.6	64.5	66.6	52.6	50.5
Chicken manure	10	48.3	55.6	59.6	61.4	48.5	48.5	64.2	63.5	49.8	45.8
	20	54.8	62.0	64.8	65.5	52.4	49.6	66.4	68.3	52.3	49.6
	30	40.2	49.6	51.3	56.3	40.3	42.3	58.4	53.4	54.8	52.4
LSD at 0.05		2.35	3.24	2.65	2.85	1.48	1.85	2.01	2.31	1.92	2.04
LSD at 0.01		3.29	4.53	3.71	3.99	2.07	2.59	2.81	3.23	2.68	2.85
Second season											
Control		42.5	55.3	48.2	52.5	40.2	43.7	50.3	53.2	35.8	37.6
Cattle manure	15	48.5	60.2	51.4	56.4	42.3	46.2	53.6	57.4	38.9	39.5
	30	55.8	61.5	59.7	64.6	46.5	49.5	58.4	59.6	42.6	44.5
	45	60.3	65.5	60.7	68.6	49.9	50.4	60.9	67.5	45.6	45.6
Chicken manure	10	51.5	62.4	54.4	56.3	45.6	46.7	55.6	59.6	40.3	43.5
	20	56.6	64.9	59.7	64.7	49.6	49.3	59.2	62.0	44.6	46.8
	30	61.2	68.3	64.7	69.7	50.2	52.3	64.0	70.3	48.6	49.6
LSD at 0.05		2.04	1.95	2.12	2.41	2.08	2.06	2.21	2.54	2.16	1.94
LSD at 0.01		2.85	2.73	2.96	3.37	2.91	2.88	3.09	3.55	3.02	2.71

Table (2): Effect of some organic manure levels on number of branches / plant for five basil varieties in two cuts during the two seasons of 2004 /2005

Varieties		Bush basil		Sweet basil		Lettuce-leaf basil		Purple Ruffles basil		Genovese basil	
Treatments (m^3 / fed)		1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut
First season											
Control		10.3	13.3	8.7	10.3	10.3	12.7	7.7	9.7	13.0	16.3
Cattle manure	15	12.3	15.7	9.7	11.0	11.7	13.3	8.7	11.0	14.7	18.7
	30	13.7	16.7	10.3	12.7	12.7	14.3	10.3	12.7	15.7	20.0
	45	14.3	17.7	12.7	13.3	14.7	16.0	11.7	14.0	16.3	21.7
Chicken manure	10	13.7	16.3	10.0	12.0	13.7	15.3	9.0	12.0	15.0	19.0
	20	15.3	18.3	11.7	13.3	15.0	16.3	10.7	13.7	16.7	21.3
	30	16.7	19.7	13.3	14.7	16.3	17.7	12.7.	14.7	17.3	22.0
LSD at 0.05		0.94	1.02	0.82	0.96	1.01	1.04	1.00	1.02	1.05	1.10
LSD at 0.01		1.31	1.42	1.15	1.24	1.41	1.45	1.40	1.42	1.47	1.54
Second season											
Control		11.3	14.7	8.3	10.0	10.0	12.3	7.3	9.3	13.3	17.0
Cattle manure	15	12.7	16.3	10.0	12.0	11.3	14.3	8.0	10.7	15.3	19.3
	30	13.7	17.3	10.7	13.0	12.0	15.0	9.3	13.3	16.0	20.7
	45	15.3	18.0	12.7	13.7	13.7	16.0	10.7	14.7	17.0	22.3
Chicken manure	10	14.3	16.7	10.7	12.7	12.7	14.7	9.0	12.7	16.3	19.7
	20	15.7	18.3	12.3	14.3	14.3	15.7	10.7	14.3	17.7	22.0
	30	17.3	19.7	14.0	15.0	15.7	17.0	12.0.	15.0	18.3	22.7
LSD at 0.05		1.01	1.04	0.98	1.03	0.97	1.01	0.95	1.01	1.06	1.11
LSD at 0.01		1.41	1.45	1.37	1.44	1.35	1.41	1.33	1.41	1.48	1.55

3- Herb fresh and dry weights

Results in Table (3 & 4) clearly showed wide significant differences in the herb fresh and dry weight of the studied basil varieties as affected with organic manures. It is clear that there is a highly significant difference between the five varieties. Sweet basil and Genovese basil varieties gave the heaviest herb fresh and dry weights with the application of cattle manure at the rate of 45 m^3 / fed, and with the application of chicken manure at the rate of 30 m^3 / fed in the two cuts during both seasons.

Table (3): Effect of some organic manure levels on herb fresh weight (g / plant) for five basil varieties in two cuts during the two seasons of 2004 / 2005

Varieties		Bush basil		Sweet basil		Lettuce-leaf basil		Purple Ruffles basil		Genovese basil	
Treatments (m^3 / fed)		1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut
First season											
Control		214	243	301	345	275	298	218	256	298	345
Cattle manure	15	289	301	325	396	289	315	248	276	327	368
	30	342	387	348	425	315	342	265	285	358	394
	45	354	400	392	436	328	368	273	301	369	415
Chicken manure	10	314	345	359	400	345	358	251	270	321	372
	20	376	396	394	438	366	389	283	297	358	395
	30	385	424	434	469	388	401	297	318	395	425
LSD at 0.05		24.3	25.7	18.3	20.5	8.9	10.2	18.6	16.8	20.4	23.7
LSD at 0.01		34.0	31.7	25.6	28.7	12.0	14.1	26.0	23.5	28.5	33.1
Second season											
Control		225	264	298	339	262	296	221	262	321	352
Cattle manure	15	292	327	316	389	296	327	253	286	348	376
	30	353	393	338	427	323	356	268	298	384	416
	45	362	409	392	443	343	382	292	326	395	428
Chicken manure	10	346	365	362	409	351	373	261	285	352	382
	20	395	416	389	446	372	394	298	302	397	423
	30	405	435	429	471	393	428	312	334	409	442
LSD at 0.05		27.3	25.8	14.7	19.4	21.1	23.5	25.6	20.6	18.7	20.0
LSD at 0.01		38.2	36.1	20.5	27.1	29.5	32.8	35.8	28.8	26.1	27.9

In this connection Hammam (1996) on *Pimpinella anisum* demonstrated that farmyard manure at 40 m^3 / fed significantly increased plant dry weight. El-Ghadban (1999) on spearmint and marjoram showed that fresh and dry weight of herb was increased by organic fertilization. Abd El-Raouf (2001) on *Ocimum basilicum* found that increasing organic fertilization up to 45 m^3 / fed significantly increased fresh and dry weight of herb / plant. Sakr (2001) on *Mentha piperita* detected that poultry manure at the rate of 20 m^3 / fed and cattle manure at 40 m^3 / fed were statistically the most efficient dose among the involved doses.

Table (4): Effect of some organic manure levels on herb dry weight (g / plant) for five basil varieties in two cuts during the two seasons of 2004 /2005

Varieties		Bush basil		Sweet basil		Lettuce-leaf basil		Purple Ruffles basil		Genovese basil	
Treatments (m^3 / fed)		1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut
		First season									
Control		47.1	51.1	60.2	69.2	55.1	59.6	43.6	51.2	59.6	69.1
Cattle manure	15	66.5	66.2	71.5	87.1	63.6	69.3	57.1	63.4	75.2	84.6
	30	78.7	92.9	80.1	97.7	74.5	78.7	61.1	68.4	82.4	98.4
	45	84.9	102	98.1	109	81.9	91.9	65.6	72.3	95.1	104
Chicken manure	10	75.5	86.3	89.8	102	86.3	89.5	62.7	67.5	80.2	93.1
	20	89.5	99	102	114	95.2	97.8	73.6	77.2	97.8	103
	30	100	110	113	122	101	104	77.2	82.7	102	110
LSD at 0.05		18.2	11.5	8.6	13.5	6.8	8.4	12.7	9.2	13.1	11.8
LSD at 0.01		25.4	16.1	12.0	18.9	9.5	11.7	17.7	12.8	18.4	16.5
		Second season									
Control		47.5	55.4	59.6	67.9	52.5	59.2	44.3	52.4	64.2	74.5
Cattle manure	15	64.2	72.1	69.2	85.6	65.2	75.2	58.2	62.9	80.1	86.5
	30	81.2	94.3	77.8	98.3	74.3	85.4	61.7	68.5	92.2	99.8
	45	86.9	102	94.1	109	82.3	95.5	72.9	81.5	98.7	107
Chicken manure	10	89.9	94.9	90.5	102	87.8	93.2	65.3	68.7	88.1	95.6
	20	103	109	97.3	112	96.7	102	74.5	75.5	99.3	110
	30	105	113	112	122	102	111	81.1	86.8	107	115
LSD at 0.05		13.4	12.7	6.9	9.4	8.6	10.2	7.3	6.7	11.8	12.6
LSD at 0.01		18.7	17.8	9.6	13.1	12.0	14.2	10.2	9.3	16.5	17.6

4- Volatile oil percentage

Results in Table (5) clearly showed significant differences in the volatile oil percentage of the studied basil varieties as affected with organic manure. Purple Ruffles basil variety gave the highest volatile oil percentage / plant with the application of cattle manure at the rate of 45 m^3 / fed and chicken manure at the rate of 20 m^3 / fed respectively, in the two cuts during the both seasons. In this connection, Jacoub (1999) on *Thymus vulgaris* L. found that organic fertilization treatments significantly increased volatile oil percentage especially with poultry manure at the rate of 20 m^3 / fed in both seasons. El-Ghawwas (2002) on *Nigella sativa* L. obtained improved the percentage of volatile oil per plant when the plants were treated with 18 m^3 / fed of the two kinds of manure (farmyard and chicken manure) in both seasons.

5- Volatile oil yield / plant

Results in Table (6) clearly showed significant differences in the volatile oil yield / plant of the studied basil varieties as affected with organic manures. Sweet basil variety gave the highest oil yield (ml / plant) with the application of cattle manure at the rate of 45 m^3 / fed and chicken manure at the rate of 30 m^3 / fed in the two cuts during both seasons. In this connection Hammam (1996) on *Pimpinella anisum* L. stated that the application of farmyard manure at 40 m^3 / fed significantly increased the essential oil yield per plant. El-Ghawwas (2002) on *Nigella sativa* L. found that the yield of volatile oil per plant was significantly improved in the two kinds of manure (farmyard manure and chicken manure) in both seasons.

Table (5): Effect of some organic manure levels on the volatile oil percentage (%) for five basil varieties in two cuts during the two seasons of 2004 / 2005

Varieties		Bush basil		Sweet basil		Lettuce-leaf basil		Purple Ruffles basil		Genovese basil	
Treatments (m^3 / fed)		1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut
		First season									
Control		0.32	0.36	0.41	0.39	0.35	0.40	0.44	0.46	0.37	0.40
Cattle manure	15	0.34	0.38	0.41	0.40	0.39	0.42	046	0.48	0.38	0.41
	30	0.35	0.39	0.42	0.42	0.40	0.43	0.48	0.50	0.39	0.43
	45	0.38	0.41	0.43	0.43	0.42	0.45	0.50	0.51	0.39	0.45
Chicken manure	10	0.36	0.40	0.42	0.43	0.42	0.45	0.49	0.50	0.38	0.44
	20	0.38	0.44	0.44	0.45	0.45	0.46	0.51	0.53	0.40	0.45
	30	0.37	0.42	0.43	0.44	0.44	0.45	0.50	0.52	0.39	0.44
LSD at 0.05		0.03	0.02	0.03	0.03	0.02	0.03	0.03	0.02	0.03	0.03
LSD at 0.01		0.04	0.03	0.04	0.04	0.03	0.04	0.04	0.03	0.04	0.04
		Second season									
Control		0.32	0.36	0.39	0.40	0.37	0.41	0.43	0.47	0.38	0.41
Cattle manure	15	0.34	0.38	0.40	0.40	0.40	0.42	045	0.49	0.38	0.42
	30	0.35	0.39	0.42	0.43	0.40	0.44	0.47	0.50	0.40	0.42
	45	0.38	0.41	0.44	0.45	0.42	0.45	0.49	0.51	0.40	0.44
Chicken manure	10	0.36	0.40	0.43	0.45	0.43	0.44	0.50	0.51	0.39	0.43
	20	0.38	0.44	0.45	0.46	0.46	0.45	0.53	0.54	0.42	0.45
	30	0.37	0.43	0.44	0.45	0.44	0.45	0.51	0.52	0.41	0..43
LSD at 0.05		0.03	0.02	0.03	0.02	0.02	0.03	0.02	0.02	0.03	0.02
LSD at 0.01		0.04	0.03	0.04	0.03	0.03	0.04	0.03	0.03	0.04	0.03

Table (6): Effect of some organic manure levels on the oil yield (ml / plant) for five basil varieties in two cuts during the two seasons of 2004 / 2005

Varieties		Bush basil		Sweet basil		Lettuce-leaf basil		Purple Ruffles basil		Genovese basil	
Treatments (m^3 / fed)		1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut	1st Cut	2nd Cut
		First season									
Control		0.15	0.20	0.25	0.27	0.19	0.24	0.19	0.24	0.22	0.28
Cattle manure	15	0.22	0.37	0.29	0.35	0.25	0.29	0.26	0.30	0.28	0.34
	30	0.28	0.38	0.33	0.41	0.30	0.34	0.29	0.34	0.32	0.42
	45	0.33	0.42	0.42	0.47	0.34	0.41	0.33	0.37	0.37	0.47
Chicken manure	10	0.32	0.38	0.37	0.44	0.36	0.40	0.31	0.34	0.3	0.41
	20	0.39	0.48	0.45	0.51	0.43	0.45	0.37	0.41	0.36	0.46
	30	0.40	0.47	0.48	0.53	0.44	0.46	0.38	0.43	0.38	0.48
LSD at 0.05		0.04	0.05	0.03	0.04	0.04	0.03	0.05	0.04	0.05	0.06
LSD at 0.01		0.06	0.07	0.04	0.06	0.06	0.04	0.07	0.06	0.07	0.08
		Second season									
Control		0.15	0.20	0.23	0.27	0.19	0.24	0.19	0.25	0.24	0.31
Cattle manure	15	0.27	0.27	0.27	0.34	0.26	0.31	0.26	0.31	0.3	0.36
	30	0.28	0.36	0.32	0.42	0.30	0.37	0.30	0.34	0.37	0.42
	45	0.33	0.41	0.41	0.49	0.34	0.43	0.36	0.41	0.39	0.47
Chicken manure	10	0.32	0.38	0.39	0.46	0.38	0.41	0.33	0.35	0.34	0.41
	20	0.39	0.48	0.43	0.51	0.44	0.46	0.39	0.41	0.42	0.49
	30	0.39	0.48	0.49	0.55	0.45	0.50	0.41	0.45	0.43	0.49
LSD at 0.05		0.06	0.05	0.04	0.06	0.05	0.04	0.05	0.04	0.06	0.05
LSD at 0.01		0.08	0.07	0.06	0.08	0.07	0.06	0.07	0.06	0.08	0.07

6- Volatile oil components

The gas liquid chromatograms illustrated in Figure (1) and Table (7) of the investigated volatile oil produced from different basil varieties under the effect of different treatments with organic fertilizer.

In general there were complex mixtures of organic compounds that give characteristic odor and flavor to plants. We evaluated further the localization of the essential oil by assaying individual varieties, depending on factors as chemotype, growth conditions and plant developing stage (Bahl *et al*., 2000).

Basil oil has marked differences in its composition which primarily is determined by genotype and depends on the major chemical compounds of the volatile oil such as monoterpenes and phenylpropanoids (Lachowicz *et al*., 1997). The volatile oil often contains monoterpenes such as linalool; methyl chavicol and ocimene identified in all basil oil varieties.

Linalool was the main compound ranged from 41.5 to 42.8 % at 30 m^3 / fed cattle manure and 20 m^3 / fed chicken manure, respectively in Sweet basil variety. As for methyl chavicol, the second main component ranged from 30.2 to 29.8 % at the same levels of organic manure in Purple Ruffles basil variety. Ocimene compound gave 17.5 to 18.5 % in Lettuce-leaf basil. Volatile oil composition varied with plant species and plant fertilization. Hammam (1996) stated that the application of farmyard manure at the rate of 40 m^3 / fed gave higher α-pinene content in anise (*Pimpenilla anisum* L.). Jacoub (1999) on *Thymus vulgaris* L. found that organic fertilizers increased thymol and carvacrol percentage in the oil. Sakr (2001) concluded that the highest rate of cattle manure (40 m^3 / fed) increased menthol percentage in *Mentha piperita* oil.

Table (7): Effect of some organic manures on number of oil components for five basil varieties during the first cut of the second season.

Varieties	Bush basil			Sweet basil			Lettuce-leaf basil			Purple Ruffles basil			Genovese basil		
Components	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3
α-pinene	1.22	1.25	1.30	1.32	1.12	1.23	0.95	0.86	0.91	1.25	1.28	1.35	1.23	1.35	1.45
β-pinene	2.30	1.98	2.01	1.15	1.45	1.34	1.65	1.38	1.59	1.91	2.01	2.15	1.58	1.62	1.75
Limonene	-	-	-	1.23	1.35	1.37	4.22	4.56	4.61	-	-	-	-	-	-
Ocimene	12.2	14.5	15.8	13.5	16.8	17.6	15.3	17.5	18.5	12.2	13.8	14.3	16.5	18.4	19.2
Linalool	32.1	36.8	37.8	36.2	41.5	42.8	32.5	36.2	37.1	29.5	35.8	37.2	30.1	36.5	37.2
Linalyl acetate	-	-	-	1.13	1.05	1.01	1.20	1.18	1.22	1.31	1.35	1.28	0.68	0.74	0.82
α-Terpineol	2.40	2.31	2.12	2.40	1.32	1.24	1.65	2.05	2.21	3.45	3.58	3.74	0.86	1.02	1.04
Benzyl acetate	3.41	3.25	3.46	2.50	2.49	1.52	-	-	-	1.21	1.35	1.54	4.25	4.65	4.89
Nerolidol	2.12	1.98	1.86	3.41	3.15	3.21	2.05	2.13	2.35	1.02	1.12	1.21	5.28	5.68	5.87
Farnesol	0.61	0.54	0.48	0.52	0.67	0.62	1.02	0.98	0.87	-	-	-	0.35	0.38	0.41
Methyl chavicol	34.2	28.5	27.9	34.2	26.3	25.8	31.5	26.6	24.3	37.2	30.2	29.8	29.5	22.5	21.6
Eugenol	1.05	1.42	1.09	1.02	1.21	1.13	2.13	2.45	2.36	1.43	1.38	1.49	0.75	1.02	1.14
Methyl cinnamate	-	-	-	0.61	0.84	0.93	-	-	-	1.65	2.04	2.15	1.35	1.64	1.72

T_1 = control T_2 = Cattle manure at 30 m^3 T3 = Chicken manure at 20 m^3

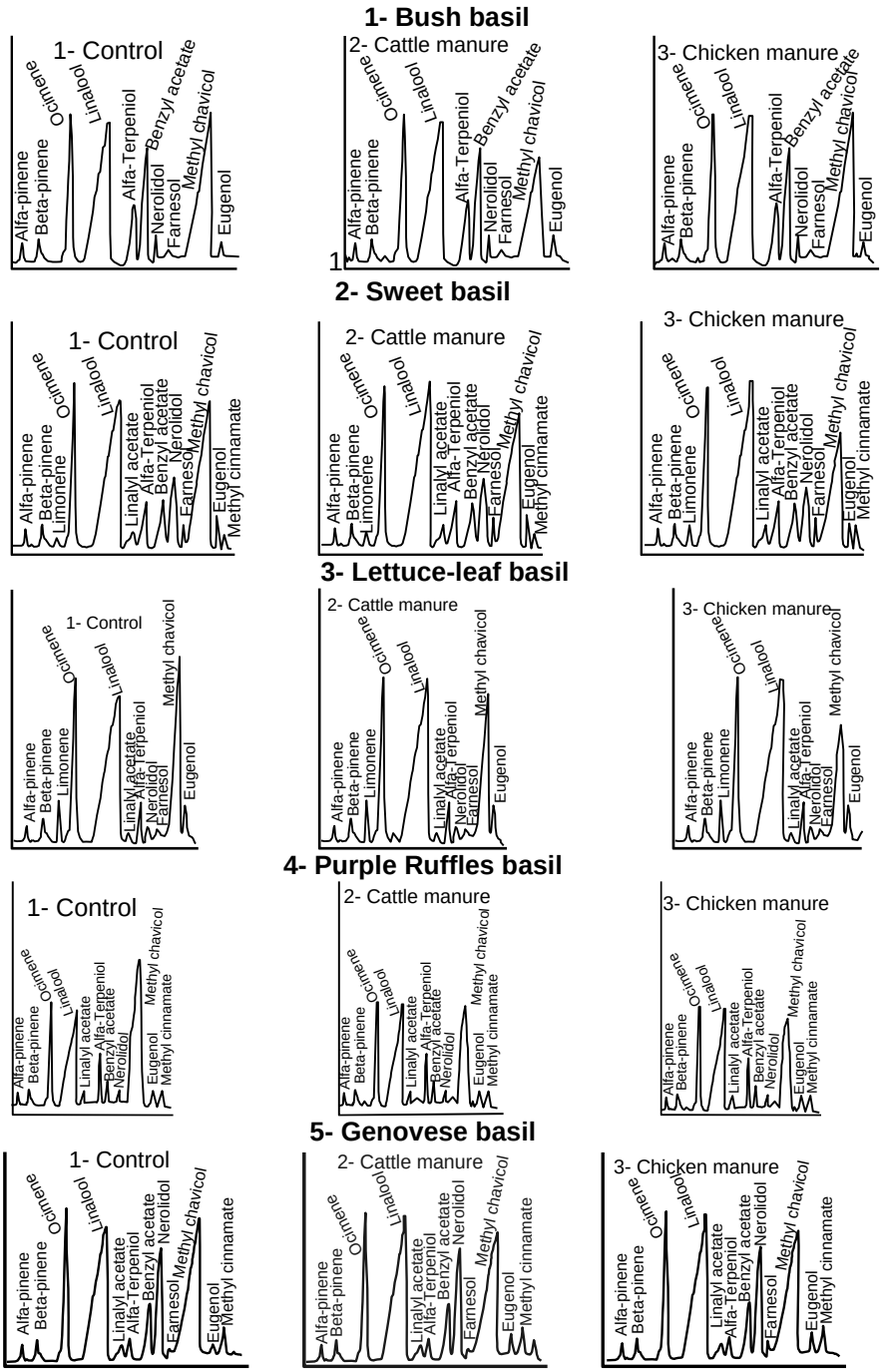

Figure (1): G LC of variety basil oil extracted from control and high levels of organic manure in first cut during the second season (2005).

7- Yearly dry herb and volatile oil yield / plant

Results in Table (8) clearly showed significant differences in the yearly dry herb and volatile oil yield / plant of the studied basil varieties as affected with organic manures. As for cultivar effect, Sweet basil variety gave the highest yearly dry herb and volatile oil yield with the application of cattle manure at the rate of 45 m^3 / fed and chicken manure at the rate of 30 m^3 / fed in the two cuts during both seasons**.** In this connection Chattopadhyay *et al*., (1993) on *Mentha arvensis* L. found that the volatile oil yield was significantly enhanced by the application of farmyard manure. Hammam (1996) stated that the application of farmyard at 40 m^3 / fed significantly increased the essential oil yield of *Pimpinella anisum* L. In another investigation, Ram and Kumar (1997) reported that treatment with farmyard was effective on enhancing the total herb of *Mentha arvensis* plants**.** Rao *et al*., (1997) on *Artemisia pallens* showed that yield of essential oil was significantly increased with the application of farmyard manure. Jacoub (1999) on *Thymus vulgaris* L. found that organic fertilization treatments significantly increased total essential oil yield per plant. El-Ghawwas (2002) on *Nigella sativa* L. found that the yield of volatile oil per plant was significantly improved in farmyard and chicken manure treatments. Abdou and Mahmoud (2003) on *Foeniculum vulgare* stated that chicken manure fertilizer significantly increased fruit yield.

Table (8): Effect of some organic manure levels on the yearly dry herb yield (g / plant) and volatile oil yield (ml / plant) for five basil varieties during the two seasons of 2004 / 2005

Varieties		Bush basil		Sweet basil		Lettuce-leaf basil		Purple Ruffles basil		Genovese basil	
Treatments (m^3 / fed)		season 1st	season 2nd	season 1st	season 2nd	season 1st	season 2nd	season 1st	season 2nd	season 1st	season 2nd
		Yearly dry herb yield (g / plant)									
Control		98	103	129	128	115	112	95	97	129	139
Cattle manure	15	133	136	159	155	133	140	121	121	160	167
	30	172	176	178	176	153	160	130	130	181	192
	45	187	189	207	203	174	178	138	154	199	206
Chicken manure	10	162	185	192	193	176	181	130	134	173	184
	20	199	212	216	209	193	199	151	150	193	209
	30	212	220	235	234	205	213	160	168	208	220
LSD at 0.05		21.5	19.6	23.1	20.7	14.2	18.9	14.2	16.7	19.8	18.5
LSD at 0.01		30.1	27.4	32.3	29.0	19.9	26.5	19.9	23.4	27.7	25.9
		Yearly volatile oil yield (ml / plant)									
Control		0.35	0.35	0.52	0.50	0.43	0.43	0.43	0.44	0.50	0.55
Cattle manure	15	0.59	0.54	0.64	0.61	0.54	0.57	0.56	0.57	0.62	0.66
	30	0.66	0.64	0.74	0.74	0.64	0.67	0.63	0.64	0.74	0.79
	45	0.75	0.74	0.89	0.90	0.75	0.77	0.70	0.77	0.84	0.86
Chicken manure	10	0.70	0.70	0.81	0.85	0.76	0.79	0.65	0.68	0.71	0.75
	20	0.87	0.87	0.96	0.94	0.88	0.90	0.78	0.80	0.82	0.91
	30	0.87	0.87	1.01	1.04	0.90	0.95	0.81	0.86	0.86	0.92
LSD at 0.05		0.10	0.12	0.09	0.12	0.14	0.16	0.14	0.13	0.08	0.09
LSD at 0.01		0.14	0.17	0.13	0.17	0.20	0.22	0.20	0.18	0.11	0.13

8- Percentage for increasing yearly dry herb and volatile oil yield / plant

Data presented in Table (9) recorded that Bush basil variety has an increases in total herb yield by 90.8 and 88.2% at the first and second seasons, respectively, and volatile oil by 114 and 111 % produced by application of cattle manure at 45 m^3 / fed, respectively, for the two cuts during both seasons.

In this concern, the same variety with chicken manure produced increases in the total herb yield by 116 and112 % respectively, and marketable volatile oil yield increases by 148 and148 % respectively, for the two cuts during both seasons. In this connection Kandeel and Abo-Taleb (2002) in field experiments with *Ocimum basilicum* obtained increases of 51 and 52 % in dry herb per plant, 113 and 139 % in oil content per plant in two seasons, when crop received 25 m^3 / fed organic manure.

Table (9): Effect of some organic manure levels on the percentage for increasing of yearly dry herb yield (g / plant) and volatile oil yield (ml / plant) for five basil varieties during the two seasons of 2004 / 2005.

Varieties		Bush basil		Sweet basil		Lettuce-leaf basil		Purple Ruffles basil		Genovese basil	
Treatments (m^3 / f ed)		season 1st	season 2nd	season 1st	season 2nd	season 1st	season 2nd	season 1st	season 2nd	season 1st	season 2nd
		Yearly dry herb yield (g / plant)									
Control		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattle manure	15	35.7	34.7	23.3	21.1	15.7	25.0	27.4	24.7	24.0	20.1
	30	75.5	73.3	38.0	37.5	33.0	42.9	36.8	34.0	40.3	38.1
	45	90.8	88.2	60.5	58.6	51.3	58.9	45.3	58.8	54.3	48.2
Chicken manure	10	65.3	63.4	48.8	50.8	53.0	61.6	36.8	38.1	34.1	32.4
	20	103	100	67.4	63.3	67.8	77.7	58.9	54.6	49.6	50.4
	30	116	112	82.2	82.8	78.3	90.2	68.4	73.2	61.2	58.3
LSD at 0.05		11.5	10.5	12.3	11.0	7.6	10.1	7.6	8.9	10.6	9.9
LSD at 0.01		16.1	14.6	17.3	15.5	10.6	14.1	10.6	12.5	14.8	13.8
		Yearly volatile oil yield (ml / plant)									
Control		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattle manure	15	68.6	54.3	23.1	22.0	25.6	32.6	30.2	29.5	24.0	20.0
	30	88.6	82.9	42.3	48.0	48.8	55.8	46.5	45.5	48.0	43.6
	45	114	111	71.2	80.0	74.4	79.1	62.8	75.0	68.0	56.4
Chicken manure	10	100	100	55.8	70.0	76.7	83.7	51.2	54.5	42.0	36.4
	20	148	148	84.6	88.0	104	109	81.4	81.8	64.0	65.5
	30	148	148	94.2	108	109	120	88.4	95.5	72.0	67.3
LSD at 0.05		11.9	14.1	12.6	8.6	11.5	8.6	10.2	12.1	11.3	11.9
LSD at 0.01		16.7	19.7	17.7	12.1	16.1	12.1	14.2	16.9	15.8	16.7

8- Chemical analysis

Data presented in Table (10) showed the chlorophyll content in fresh leaves of basil plants as affected by different levels of organic fertilization. It could be concluded that all treatments led to increase chlorophyll content. The highest value was observed due to fertilization with 45 m^3 cattle manure / fed and 30 m^3 chicken manure / fed, respectively. However, highest values were obtained from Sweet basil variety in both cuts during the two growing seasons.

Table (10): Effect of some organic manure levels on the chlorophyll content in fresh leaves of five basil varieties during the two seasons of 2004 /2005

Varieties		Bush basil		Sweet basil		Lettuce-leaf basil		Purple Ruffles basil		Genovese basil	
Treatments (m^3 / fed)		1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut	1st cut	2nd cut
First season											
Control		28.5	31.5	31.2	33.4	26.8	27.4	29.5	30.2	29.8	30.5
Cattle manure	15	29.0	32.1	32.0	34.3	28.5	29.2	30.2	30.9	30.5	31.2
	30	30.5	33.7	33.4	35.8	30.1	30.8	31.2	31.9	32.8	33.6
	45	31.0.	34.1	33.8	36.2	30.8	31.5	32.5	33.3	33.7	34.5
Chicken manure	10	30.0	33.2	32.5	34.8	30.2	30.9	30.1	30.8	32.7	33.5
	20	32.5	35.9	33.8	36.2	33.4	34.2	32.0	32.8	33.8	34.6
	30	33.5	37.0	34.5	36.9	33.8	34.6	32.5	33.3	34.2	35.0
Second season											
Control		28.9	31.9	31.6	33.9	27.2	27.8	29.9	30.6	30.2	30.8
Cattle manure	15	29.4	32.5	32.4	34.8	28.9	29.6	30.6	31.3	30.9	31.6
	30	30.8	34.2	33.9	36.3	30.5	31.2	31.6	32.3	33.2	34.1
	45	31.5	34.6	34.3	36.7	31.2	31.9	32.9	33.7	34.2	35.0
Chicken manure	10	30.5	33.6	32.9	35.3	30.6	31.3	30.5	31.2	33.1	34.0
	20	32.8	36.4	34.3	36.7	33.9	34.7	32.4	33.2	34.3	35.1
	30	33.8	37.5	35.0	37.4	34.3	35.1	32.9	33.7	34.7	35.5

Concerning the effect of organic fertilizers, data in Table (11), indicated that N, P and K percentages were statistically influenced by manure fertilization.

Data showed that the N, P and K percentages in basil leaves were varied with plant species and plant fertilization, treating plants with all levels of organic manure caused an increase in the N, P and K percentages during the two seasons. The highest values of N (%) were observed from Sweet basil, Lettuce-leaf basil and Purple Ruffles basil varieties, respectively. The highest values of P (%) resulted from Lettuce-leaf basil, Genovese basil and Bush basil varieties, respectively. The highest values of K (%) resulted from Genovese basil, Purple Ruffles basil and Lettuce-leaf basil varieties, respectively. Also, it was obvious that the percentages were increased at all levels of organic manure.

The highest level of cattle manure caused considerable effect of N, P and K percentages. Plants treated with the highest level of chicken manure resulte the highest N, P and K percentages. These results were true and similar in the two seasons of the experiment. These results are in accordance with those obtained by Rao *et al*. (1997) on *Artemisia pallens*, Jacoub (1999) on *Thymus vulgaris* and Sakr (2001) on *Mentha piperita*. In another investigation, Kandeel and Abo-Taleb (2002) in field experiments with *Ocimum basilicum showed* that chlorophyll content, N, P and K percentages were increased when crop received 25 m^3 / fed organic manure in the two seasons.

Table (11): Effect of some organic manure levels on macro elements percentage (%) for five basil varieties during the two seasons of 2004 / 2005.

Varieties		Bush basil			Sweet basil			Lettuce-leaf basil			Purple Ruffles basil			Genovese basil		
Treatments (m^3 / fed)		N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
First season																
Control		3.01	0.19	3.25	3.15	0.17	3.35	3.24	0.20	3.19	3.02	0.18	3.31	3.11	0.19	3.22
Cattle manure	15	3.14	0.23	3.45	3.25	0.21	3.46	3.26	0.23	3.38	3.19	0.23	3.49	3.19	0.25	3.76
	30	3.22	0.24	3.58	3.27	0.25	3.59	3.32	0.25	3.59	3.28	0.26	3.67	3.24	0.27	3.86
	45	3.27	0.28	3.73	3.38	0.26	3.67	3.37	0.29	3.79	3.35	0.28	3.89	3.31	0.29	3.90
Chicken manure	10	3.16	0.27	3.56	3.26	0.24	3.61	3.29	0.26	3.57	3.25	0.25	3.62	3.27	0.26	3.81
	20	3.25	0.30	3.79	3.36	0.27	3.75	3.37	0.28	3.74	3.38	0.28	3.75	3.32	0.28	3.89
	30	3.28	0.31	3.85	3.39	0.29	3.83	3.42	0.30	3.90	3.43	0.29	3.91	3.36	0.30	3.92
Second season																
Control		3.05	0.19	3.26	3.19	0.19	3.38	3.28	0.22	3.23	3.06	0.20	3.34	3.17	0.22	3.24
Cattle manure	15	3.18	0.24	3.45	3.29	0.22	3.50	3.30	0.24	3.42	3.23	0.25	3.53	3.23	0.27	3.81
	30	3.26	0.25	3.58	3.31	0.26	3.63	3.36	0.26	3.63	3.32	0.27	3.72	3.28	0.28	3.91
	45	3.31	0.29	3.73	3.42	0.27	3.72	3.41	0.30	3.84	3.39	0.29	3.94	3.35	0.30	3.95
Chicken manure	10	3.20	0.28	3.56	3.30	0.25	3.65	3.33	0.27	3.61	3.29	0.26	3.67	3.31	0.27	3.86
	20	3.29	0.31	3.79	3.40	0.28	3.80	3.41	0.29	3.79	3.42	0.29	3.80	3.36	0.29	3.94
	30	3.32	0.32	3.85	3.43	0.30	3.88	3.46	0.29	3.95	3.47	0.30	3.96	3.40	0.31	3.97

Recommendation

The present study revealed that, among the different basil varieties, sweet basil was superior in growth, commercial dry herb and the highest productivity of volatile oil with high concentrations of linalool and methyl chavicol so that it could be introduced to basil cultivation in Egypt replacing the local variety. The highest values were obtained for the plants treated with the highest level of cattle manure (45 m^3 / fed) and chicken manure (30 m^3 / fed) at two cuts in both seasons. Many studies, carried out in different locations reported the response of organic manure on growth, yield and the main components of medicinal and aromatic plants. Organic manure (FYM and CKM) could be used to enhance the growth and obtain a good basil herb and oil yield without chemical fertilization. Chemical fertilizers affect the quality of our air, water and soil. Chemicals are not good for the human body. Organic fertilizer is healthier for our families, and better for the environment. Organic fertilizer is cheaper, while, chemicals cost money. For centuries people farmed the land without chemicals; we can identify with that process to avoid using chemicals.

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تقييم بعض أصناف الريحان وإستجابتها لبعض الأسمدة العضوية

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يعتبر نبات الريحان من النباتات الطبية التى تزرع فى مصر حيث أن لـه قيمـة إقتصـادية عاليـة. وتتزايد المسـاحات المنزرعة من الريحان الحلو فى دول حوض البحر الأبيض المتوسط فى السنوات الحالية إعتمادا على زيادة الطلب فى السوق الاوروبى.
وقد أجريت تجربتان حقليتان فى مزرعة النباتات الطبية والعطرية بكلية الزراعة- جامعة المنصورة خلال موسميين صيفيين ناجحيين ٢٠٠٤ / ٢٠٠٥ لدراسة تأثير مستويات ١٥, ٣٠ , ٤٥ م٣ / فدان من السماد البلدى ومستويات ١٠, ٢٠, ٣٠ م^{3} / فدان من سماد زرق الدواجن على النمو و محتوى الزيت الطيار ومكوناته لخمسة سلالات من الريحان. هى الريحان القصير والريحان الحلو والريحان المجعد والريحان الأحمر (الصنف المحلى) والريحان العريض (الصنف الألمانى)
حيث أوضحت النتائج المتحصل عليها أن إضافة السماد البلدى وسماد زرق الدواجن قد أعطيا فروقا معنوية فى طول النبات وعدد الافرع والوزن الطازج والجاف للنبات وأيضا محصول العشب للنبات. فضلاعن زيادة محتوى الكلوروفيل والنسبة المئوية لكل من النتروجين والفوسفوروالبوتاسيوم خلال موسمى الزراعة. هذا وقد تأثرت النسبة المئوية للزيت الطيار ومكوناته الكيميائية تبعا لاصناف الريحان وأنواع الأسمدة العضوية المستخدمة. وغالبا ما يحتوى الزيت على مكونات تربينية مثل لينالول- ميثيل شافيكول- أوسيمين. وكانت هناك فروق معنوية فى هذه الصفات نتيجة المعاملة بمعظم مصادر السماد العضوى.
ولقد تحققت أعلى قيمة عند معاملة النباتات بالمستوى الأعلى من السماد بلدى (٤٥ م^{3} / فدان) ومن سماد زرق دواجن (٣٠ م^{3} / فدان) فى كلا الحشتين خلال موسمى الزراعة.
وأدى إضافة السماد البلدى الى زيادة نمو نبات الريحان ومحصول العشب والزيت الطيار مقارنة بمعاملة الكونترول بينما إضافة سماد زرق الدواجن كان أفضل المعاملات للحصول على أعلى نمو خلال موسمى الزراعة. ومن المؤكد أيضا أن إضافة معاملات التسميد قد أدت الى تحسين نمو النباتات.
ويعتبر صنف الريحان الحلو من أحسن السلالات بالنسبة الى إنتاجية محصول العشب والزيت وأيضا الوزن الطازج والجاف للنبات ومحتوى الزيت الطيار ومكوناته. بينما أعطى صنف الريحان الأحمر أفضل نمو مع مستويات السماد العضوى المختلفة التى أظهرت فروقا معنوية فى صفات النمو الخضرى مثل طول النبات وعدد الأفرع للنبات مقارنة بنباتات الكونترول.

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