

EFFECT OF PROPAGATION METHODS AND ORGANIC FERTILIZATION ON GROWTH AND CHEMICAL CONSTITUENTS OF *OCIMUM BASILICUM* L., 'SWEET BASIL.'

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ABSTRACT

Two field experiments were carried out during the two successive years of 2004 and 2005) to study the effect of propagation methods (seedlings from seeds and terminal cuttings) alone or with using organic manure fertilizer such as farm yard manure "FYM" or poultry manure "PM" at rates 0, 10, 20 and 30 m³/ fed. on growth and chemical constituents of sweet basil plants. The obtained results indicated that, all growth parameters i.e., plant height, number of branches/plant, number of inflorescences/plant, fresh weight of herb/plant and number of roots as well as volatile oil percentage, oil yield per plant and per feddan, N, P and K % and total carbohydrate contents in the herb were significantly increased as methods of propagation such as terminal cuttings and organic manure application of poultry manure. The best results were obtained from poultry manure at rate of 20 m³/fed. or farm yard manure at rate of 30 m³/fed. Also cultivate terminal cuttings combined with organic manure fertilization gave the best results than seedlings combined with organic manure fertilization. Terminal cuttings combined with poultry manure gave the best results than other combines. The maximum increment in the studied growth parameters and chemical constituents as well as yield and its component were obtained by cultivate with terminal cuttings using medium rate 20 m³/fed. from poultry manure or high rate 30 m³/fed. from farm yard manure at rate of 30 m³/fed. fertilization.

Key words: Sweet basil (*Ocimum basilicum* L.) propagation methods (seedlings and terminal cuttings) and organic manure, farm yard manure "FYM", poultry manure "PM", growth parameters and chemical constituents.

INTRODUCTION

Sweet basil (*Ocimum basilicum* L.) is a popular aromatic and medicinal plant of Lamiaceae and is well known for its highly aromatic leaves used either fresh or dried and for culinary of the 150 species of *Ocimum basilicum* L. It is most important species being utilized as a source of essential oil (Hussein *et al.*, 1988). Basil can be grown from seeds or cuttings; this is particularly helpful for preserving the integrity of unusual varieties. Several basil species have antimicrobial and antifungal properties (Blumenthal, 1998 and Opalchenova and Obreshkova, 2003) and anti-cancer properties (Aruna and Sivaramakrishnan, 1992). It is also used as an ingredient of cough-relieving, stomachache, diuretic, carminative tea blends and can lower blood sugar levels and aid "insulin release (Nyarko, 2002). It is used in food industries for spicing canned drinks (Hornok, 1992). Essential oil that used in

manufacturing perfumes, soaps and shampoos. (*Ocimum basilicum* L.var. difform Benth) is one of the introduced varieties, have been cultivate in a private farm in Sennouris, Fayoum Governorate, for obtained the high yield of *Ocimum basilicum* L. and neutral production to keep our healthy and animal health we must cultivate using terminal cuttings and faraway from the comical cultural or used at least smallest amount of it, as well as organic cultural. The organic matter content of Egyptian soil is usually less than 2% in cultivate area. Frequent and high application of organic manure are necessary to maintain soil fertility and to provide the growing plants with their nutritional requirements without having an undesirable impact on the environment, organic fertilization also provides a means for alleviating the problem of chemical residues in the exporting market.

Abd El-Raouf (2001) found that increasing organic fertilization level as compost due to increasing the plant height, number of branches/plant, number of inflorescences/plant, fresh weight/plant and volatile oil percentage, yield in the herb per plant and per feddan of sweet basil.

El-Gendy et al., (2001) reported that, the treated sweet basil plants with organic manure as compost at rates 15, 25, 35, 45, 55 and 65 m³/fed. caused to increases in growth characters/plant i.e., plant height, number of branches, and herb fresh weights and volatile oil percentage, yield in the herb per plant and per feddan.

Matter and Mohamed (2001) on *Calendula officinalis* L. plants investigated the effect of farmyard manure or poultry manure application and found that the plant height, number of branches, dry weight of shoots/plant, number of inflorescences/plant, pigment content, N, P and K and total carbohydrates were significantly increased by increasing the rates from 0 to 200 g/pot for the two organic types, and found that poultry manure gave the best result than farmyard manure

Mohamed and Matter (2001) showed that the poultry manure and farmyard manure at rates (0, 4 and 8 t/fed.) on *Tagetes minuta* L. significantly increased the plant height, number of branches/plant, fresh of shoots, number of inflorescences, chlorophyll a ,b and carotenoids, volatile oil percentage, yield in the herb per plant and per feddan and N, P, K. The best effect in this respect was obtained by poultry manure.

Sakr (2001) on *Mentha piperita* L. plants studied the effect of organic manure at rates, 5 , 10 and 20 m³/fed. as poultry, 10, 20 and 40 m³/fed. as cattle manure and 10 ,20 and 30 m³/fed. as sheep manure and found that, poultry manure at 20 m³/fed. was statistically increased and the most efficient dose among the involved doses of the different manure fertilizers followed by sheep manure at 30 m³/fed. and cattle manure at 40 m³/fed. on vegetative characters chlorophyll a, b, total chlorophyll, carotenoids, N, P, K and total carbohydrates.

Somida, (2002) found that treating the *Tagetes minuta* plants with poultry manure at rates 4, 8, 12 m³ enhanced the plant height, number of branches, fresh weight of herb, number of inflorescences, volatile oil percentage and yield in the herb per plant and per feddan, chlorophyll a, b, carotenoids, N, P, K and total carbohydrate contents.

Adams, (2003) growing basil from cuttings is relatively easy and is important if you want to prevent crossing.

El-Yazal, et al., (2005) recorded that, poultry manure at rates of 10 and 15 m³ produced the best results from plant height, number of branches,

fresh weight of herb, number of inflorescences, volatile oil percentage and yield in the herb per plant and per feddan, N, P and K total carbohydrate on sweet basil.

Mohamed (2006) studied the effect of organic fertilizer sources (namely: poultry, farm yard and sheep manure) at rates 15, 20, 25 and 30 m³/fed. on *Hibiscus sabdariffa* L. plants and found that, the high rate 30 m³/fed. of organic was more effective. Poultry manure gave the best result and followed by farm yard and then sheep manure on this characters, plant height, number of branches/plant, number of capsules/plant, dry weight of leaves/plant, chlorophyll a, b, carotenoids, N, P, K and total carbohydrates.

This study was conducted with the aim of studying the effect of propagation methods (terminal cuttings and seedlings) alone or combined with organic manure such as farm yard manure "FYM" and poultry manure "PM" on the growth, oil yield and chemical composition of the *Ocimum basilicum* L. plants.

MATERIAL AND METHODS

The present investigation was carried out during the two successive seasons of 2004 and 2005 in farm in Sennouris Center, Fayoum Governorate. Seeds of *Ocimum basilicum* L., were obtained from the Research Center of Medicinal and Aromatic plants in Giza, Egypt in both seasons of the study. On April 1th of each season, seeds were sown in a well prepared seed bed in the same farm. Uniform seedlings or terminal cuttings of 10 cm length were transplanted on May 15th in the two seasons. Split split plot design with three replicates was used. Application methods of propagation (seedlings and terminal cuttings) were arranged in the main plots, while sources of organic manure were allocated in sub-blots and organic manure levels in sub-sub plots. The experiment comprised 16 treatments; each replicate contained one plot (2x2 m) each plot contained 4 rows (50 cm apart) (2x2m) and distance between plants was 30 cm, each plot contained 28 plants.

Organic manure such as farm yard manure (FYM) or poultry manure (PM) was obtained from private farms. The chemical and physical analysis of used soil and organic fertilizers are shown in Table (1). Organic manure at the rates 0, 10, 20 and 30 m³/fed. were applied into two doses. The first dose was incorporated with the soil before planting about two weeks and the second dose was applied as basal dressing after the first cut.

Table (1): Chemical and physical analysis of used soil and organic fertilizers

| Properties | | Soil | FYM | PM |
|-----------------|----|-----------|-------|-------|
| Sand | | 20.90 | - | - |
| Silt | | 32.22 | - | - |
| clay | | 22.9 | - | - |
| Texture grade | | Loam sand | - | - |
| Organic matter% | | 1.72 | 16.50 | 70.20 |
| PH | | 7.50 | 7.50 | 6.30 |
| Ec mm /cm | | 4.50 | 1.50 | 7.00 |
| Total N % | | 0.60 | 1.5 | 3.32 |
| Available mg/kg | P | 25.00 | 22.00 | 38 |
| | K | 650 | 700 | 725 |
| | Zn | 0.73 | 11 | 160 |
| | Mn | 2.90 | 30 | 120 |
| | Cu | 1.26 | 4 | 22.00 |
| | Fe | 3.62 | 146 | 1958 |

Organic manure at the rates 0, 10, 20 and 30 m³/fed. were applied into two doses. The first dose was incorporated with the soil before planting about two weeks and the second dose was applied as basal dressing after the first cut.

Plants were treated with phosphorus at rate 200 kg/fed. in the form of calcium superphosphate 15 % P₂O₅, nitrogen at rate 100 kg/fed. in urea form, and potassium sulfate (48% K₂O) at rate 50 Kg/fed. The amount of fertilizers were divided into two equal doses and applied as basal dressing. The first dose was added after three weeks from transplanting, the second dose after three weeks from the first cut. Two cuts were taken after flowering, the first cut was taken on 15th July and the second cut was taken on 15th September in which plant height, number of branch, number of inflorescences, fresh weight of herb and number of roots was recorded for each replicate. Chlorophyll a, b and carotenoids (mg/100g. F.wt.) were determined in fresh leaves according to **Welburn and Lichtenthaler (1984)**. Total carbohydrates (mg/g. D.W.) were determined colorimetric according to the method described by **Herbert, et al., (1971)** Nitrogen and phosphorus% was determined according to **A.O.A.C. (1995)**. Potassium was determined by Flame Photometer, Parkin–Elmer model 52 with acetylene burner according to **Page et al., (1982)**. The essential oil percentage was determined in the herb according to **British Pharmacopoeia method (1983)** by using Clevenger apparatus for the determination of essential oil. Data were statistically analyzed according to **Gomes and Gomes (1983)**.

$$\text{Essential oil percentage} = \frac{\text{Essential oil quantity (ml)}}{\text{Fresh weight of sample (100 gm)}}$$

Data presented in the Tables of this investigation show the mean of the two experimental seasons

RESULTS AND DISCUSSIONS**A - Vegetative growth characteristics:****1 – Plant height (cm):**

Data in Table (2) indicated that plant height was significantly affected by propagation method. Terminal cuttings increased the plant height than the seedling by 1.41 and 1.32 % in the two cuts of sweet basil plants.

Application of organic manure such as poultry manure significantly surpassed the farm yard manure by 0.90 and 1.23 % in two cuts of the tallest plants Table (2). The results are agreement with those obtained by **Jacoub (1999)** on *Ocimum basilicum* L., **Abd El-Moez et al., (1999)** on fennel and coriander plants, **Mohamed and Matter (2001)** on *Tagetes minuta* L. **Sakr (2001)** on *Mentha piperta* L., and **Mohamed (2006)** on roselle plants.

All organic manure rates used in the study significantly increased the plant height as compared to the control plants in both cuts. At the meantime both medium level 20 m³/fed. (PM) and high level 30 m³/fed. (FYM) was statistically equal in producing significant plant height in the both cuts. So the highest values were obtained when *Ocimum basilicum* L. plants received poultry manure at rate of 20 m³/fed from poultry manure (PM) and high rate 30 m³/fed. farm yard manure (FYM). These results are in agreement with the findings reported by **Aly (1999)** on *Nigella sativa* L., and **Abd EL-Raouf (2001)**, **El-Gendy et al., (2001)** and **El-Yazal, et al., (2005)** on *Ocimum basilicum* L.

The method of propagation such as terminal cutting combined with organic manure gave the tallest plants than the seedlings combined with organic manure in both cuts.

The most effective treatments that gave the tallest plants was terminal cutting method combined with poultry manure in both cuts.

2- Number of branches per plant:

Table (2) show that propagation method was significantly affected in number of branches/plant. The data show that the terminal cuttings gave the highest number of branches/plant of *Ocimum basilicum* L. plants than seedlings by about 49.69 and 42.16 % in both cuts.

The differences in number of branches/plant between the two organic manure were significant for the sweet basil. Poultry manure application significantly increased the number of branches/plant than the farm yard manure by 12.82 and 10.94 % in two cuts. The increase in number of branches in response to poultry manure fertilization treatments has been observed by **El-Ghadban (1998)** and **Mansour et al., (1999)** on spearmint and marjoram, **Matter and Mohamed (2001)** on *Calendula officinalis* L., **El-Yazal, et al., (2005)** on *Ocimum basilicum* L. and **Mohamed (2006)** on roselle plants.

Application of organic manure rates significantly increased the number of branches/plant over with control plants by 20.32, 34.79 and 39.87 %; 16.54, 31.49 and 35.35 %, respectively in both cuts. At the meantime both medium level 20 m³/fed (PM) and high level 30 m³/fed. (PM) were statistically equal in producing significant number of branches/plant in the both cuts. So the highest values were obtained when *Ocimum basilicum* L. plants received poultry manure at rate of 20 m³/fed. from poultry manure (PM) and high rate 30 m³/fed. farm yard manure (FYM). These results are in agreement with the findings reported by **Abd El-Raouf (2001)**; **El-Gendy et**

al., (2001) and *El-Yazal, et al.*, (2005) on *Ocimum basilicum* L. and *Mohamed and Matter* (2001) on *Tagetes minuta* L.

The combined of terminal cuttings and organic manure gave the higher number of branches/plant as compared to the other combinations in both cuts.

The highest number of branches/plant which obtained by cultivate with terminal cutting combined with the poultry manure which surpassed the other combined in both cuts.

3 – Number of inflorescences per plant:

Table (2) indicate reported that number of inflorescences per plant significantly increased by propagation methods. Terminal cuttings increased number of inflorescences per plant over the seedling by 26.66 and 17.84 % in two cuts.

Application of organic manure significantly increased number of inflorescences per plant of *Ocimum basilicum* L. in both cuts. Poultry manure surpassed the farm yard manure by 2.44 and 3.70% in two cuts of the number of inflorescences per plant. These results are agreement with those obtained by *Jacoub* (1999) on *Ocimum basilicum* L., *Abd El-Moez et al.*, (1999) on fennel and coriander plants, *Mohamed and Matter* (2001) on *Tagetes minuta* L. and *Mohamed* (2006) on roselle plants.

All organic manure rates significantly increased the number of inflorescences per plant. The rate of increase was 3.39, 9.38 and 12.51; 8.52, 14.66 and 18.07 %, respectively over control in both cuts. At the meantime both medium 20 m³/fed. (PM), high rate 30 m³/fed. (PM) and high rate 30 m³/fed. (FYM) were statistically equal in producing significant number of inflorescences per plant in the both cuts. So the highest values were obtained when *Ocimum basilicum* L. plants received poultry manure at rate of 20 m³/fed. from poultry manure (PM) and high rate 30 m³/fed. farm yard manure (FYM). These results are in agreement with the findings reported by *Abd El-Raouf* (2001), *El-Gendy et al.*, (2001) and *El-Yazal, et al.*, (2005) on *Ocimum basilicum* L. and *Mohamed and Matter* (2001) on *Tagetes minuta* L.

The terminal cuttings combined with organic manure gave higher number of inflorescences per plant than the seedlings combined with organic manure in both cuts.

The most effective treatments that gave the higher number of inflorescences per plant was terminal cuttings combined the poultry manure.

4 – Herb fresh weight per plant (g) :

The results presented in Table (3) show that applied of propagation methods used in this study significantly increased the herb fresh weight per plant in the two cuts. It showed that the terminal cuttings gave the highest herb fresh weight/plant of *Ocimum basilicum* L. plants than seedlings by 48.85 and 27.88 % in both cuts.

Data revealed that the fresh weight of the herb increased gradually by organic manure treatments. The source of organic fertilizer such as poultry manure which followed by the farm yard manure fertilization increased fresh herb/plant over control by about 2.12 and 1.50 % in two cuts. The results are in agreement with those obtained by *El-Ghadban* (1998) and *Mansour et al.*, (1999) on spearmint and marjoram , *Matter and Mohamed* (2001) on *Calendula officinalis* L., *El-Yazal, et al.*, (2005) on *Ocimum basilicum* and *Mohamed* (2006) on roselle plants.

Table 2

Increasing the levels of organic fertilizers used in the study significantly increased the fresh weight of the herb/plant by 5.67, 12.57 and 15.03; 3.92, 9.45 and 10.89 %, respectively over the control plants in both cuts. In the meantime both medium 20 m³/fed. (PM), high rate 30 m³/fed. (PM) and high rate 30 m³/fed. (FYM) were statistically equal in producing significant fresh weight of the herb per plant in the both cuts. So the highest values were obtained when *Ocimum basilicum* L. plants received poultry manure at rate of 20 m³/fed from poultry manure (PM) and high rate 30 m³/fed. farm yard manure (FYM). These results are in harmony with those reported by Sakr (2001) on *Mentha piperta* L.; Abd El-Raouf (2001), El-Gendy *et al.*, (2001) and El-Yazal, *et al.*, (2005) on *Ocimum basilicum* L. and Mohamed and Matter (2001) and Somida (2002) on *Tagetes minuta* L.

The results in the Table (3) show that fresh weight of the herb/plant was significantly affected by interaction among to the studied factors except the interaction between methods of propagation x organic sources in the both cuts. The terminal cutting combined with organic manure gave the highest fresh weight of the herb/plant than the seedlings combined with organic manure in both cuts. The most effective treatment that gave higher fresh weight of herb/plant was the terminal cutting combined the poultry manure which surpassed the other combined in both cuts.

5- Number of roots per plant:

Table (3) reported that number of roots per plant significantly increased by propagation method. Terminal cuttings gave the highest number of roots per plant than the seedling by 29.00 and 23.41% in two cuts of *Ocimum basilicum* L.

Organic manure significantly increased number of roots per plant of *Ocimum basilicum* L. in both cuts. Poultry manure surpassed the farm yard manure by 4.15 and 3.14 % in two cuts of the number of roots per plant. These results are in harmony with those reported by Abd El-Kader (1999) on fennel and anise.

Table (3) recorded that, all organic manure rates significantly increased the number of roots per plant by 17.56, 33.36 and 36.47; 8.08, 13.05 and 15.35 %, respectively over control plants in both cuts. At the meantime both medium 20 m³/fed. (PM), high rate 30 m³/fed. (PM) and high rate 30 m³/fed. (FYM) were statistically equal in producing significant number of roots per plant in the both cuts. So the highest values were obtained when *Ocimum basilicum* L. plants received poultry manure at medium rate of 20 m³/fed from poultry manure (PM) and high rate 30 m³/fed. farm yard manure (FYM) .

The propagation method such as terminal cuttings combined with organic manure gave higher the number of roots per plant than the seedlings combined with organic manure in both cuts.

The most effective treatments that gave the higher number of roots per plant were terminal cuttings combined the poultry manure which followed by the other combined treatments in both cuts.

In order to discuss and explain the promoting effects of both organic manure which contained macro and micro elements as shown in Table (1) on different vegetative growth characters, as well as other yield component parameters and oil production of *Ocimum basilicum* L. plants. It is necessary to refer to the physiological roles of the nutrients such as nitrogen and potassium in plant growth and development. Nitrogen is a constituent of most

Table 3

organic compounds such as amino acids, many enzymes and energy transfer materials such as chlorophyll, ADP and ATP. Growing plants must have nitrogen to form new cells and the rate of growth is proportional to the rate at which nitrogen is supplied. Photosynthesis can produce carbohydrate from CO₂ and H₂O but the process can not go on to the production of proteins. Thus, a severe shortage of nitrogen will effect on the processes of growth and production. The other macronutrient involved in the present study is potassium. It needed in relatively large amounts by all plants. It aids in the uptake of other nutrients and their movement within the plant. **Beringer (1978)** and **Mengel and Kirkby (1987)** reported that the role of K in metabolism, growth and yield formation can be characterized by two major function: as an activator of enzymes and as K⁻ ions are very mobile within the plant as well as within a cell are transported through biological membranes with high rate and specificity. More than 60 enzymes are known to require K⁺ as an activator. The high mobility of K⁺ on photosynthesis phloem loading and phloem transport...etc. Such two nutrients are among the major essential elements needed in large quantities for all plants. They participate directly or indirectly in much important physiological process carried on simultaneously within plant cells, tissues and organs differentiation. Plant supplement with these macronutrients in soil of fertilizers is necessary because the soil is usually in deficient of them or they are not readily available for plants. Such important physiological roles enable potassium to perform its functions, which lead to an increase in various vegetative growth, yield and oil aspects. Micronutrients in sort of fertilizers are necessary because the soil is usually in deficient of them or they are not readily available for plants. Terminal cuttings of propagation is more easy methods of propagation to gave higher product because contained the maximum number of roots as shown in (Table 3) which increased the absorption coefficient from the soil. Therefore, *Ocimum basilicum* L. plants enhanced different vegetative characters and chemical component by this treated

B-Chemical composition

1 – Volatile oil percentage of herb:

Results in Table (4) showed that applied propagation was significantly affected in volatile oil percentage/plant. It was clear from the results that terminal cuttings gave the highest volatile oil percentage/plant of *Ocimum basilicum* L. plants than seedlings by 2.78 and 2.80 % in both cuts.

The differences in volatile oil percentage/plant between the two organic manure were significant for the sweet basil. Poultry manure application significantly increased the volatile oil percentage/plant than the farm yard manure by 1.85 and 1.87 % in two cuts. The increase in volatile oil percentage/plant in response to poultry manure fertilization treatments has been observed by **Abd El-Raouf (2001)**, **El-Gendy et al., (2001)** and **El-Yazal, et al., (2005)** on *Ocimum basilicum* L. and **Mohamed and Matter (2001)** and **Somida (2002)** on *Tagetes minuta* L.

Application of organic manure rates significantly increased the volatile oil percentage per plant as compared to the control plants by 9.57, 25.53 and 28.72; 10.75, 25.80 and 29.03 %, respectively in both cuts. In the meantime both medium 20 m³/fed. (PM), high rate 30 m³/fed. (PM) and high rate 30 m³/fed. (FYM) were statistically equal in producing significant oil percentage per plant in the both cuts. So the highest values were obtained when *Ocimum basilicum* L. plants received poultry manure at rate of 20 m³/fed. from

poultry manure (PM) and high rate 30 m³/fed. farm yard manure (FYM), Table (4). These results are in agreement with the findings reported by **Abd El-Raouf (2001)**, **El-Gendy et al., (2001)** and **El-Yazal, et al., (2005)** on *Ocimum basilicum* L. and **Mohamed and Matter (2001)** and **Somida (2002)** on *Tagetes minuta* L.

The combined with terminal cutting and organic manure gave the higher volatile oil percentage per plant compared to the other combined in both cuts.

The highest volatile oil percentage per plant which obtained by the cultivate with terminal cutting combined with the poultry manure which surpassed the other combined in both cuts.

2 - Volatile oil yield of herb per plant (ml):

The data listed in Table (4) show that volatile oil yield/plant in the herb of *Ocimum basilicum* L. plant was significantly affected by different propagation methods. It took similar trend to that of oil percentage. A gradual rise in the yield of volatile oil per plant accompanied by the different propagation methods. It was clear from the results that terminal cuttings gave the highest volatile oil yield/plant of *Ocimum basilicum* L. plants than seedlings by 53.31 and 31.15 % in both cuts.

Data in Table (4) indicated that, the difference in volatile oil yield/plant between the two organic manure was significant for the sweet basil. Poultry manure application significantly increased the volatile oil yield/plant than the farm yard manure by 4.18 and 3.31% in two cuts. The increase in volatile oil percentage/plant in response to poultry manure fertilization treatments has been observed by **Mohamed and Matter (2001)** and **Somida (2002)** on *Tagetes minuta* L. and **Sakr (2001)** on spearmint plants.

A gradual rise of organic manure rates significantly increased the volatile oil yield per plant as compared to the control plants by 15.81, 41.54 and 48.16; 14.97, 37.70 and 43.05 %, respectively in both cuts. In the meantime both medium 20 m³ fed. (PM), high rate 30 m³/fed. (PM) and high rate 30 m³/fed. (FYM) were statistically equal in producing significant volatile oil yield in the both cuts. So the highest values of volatile oil yield were obtained when *Ocimum basilicum* L. plants received organic manure at rates of 20 m³/fed from poultry manure (PM) or high rate 30 m³/fed. from farm yard manure (FYM), Table (4). These results are in agreement with the findings reported by **Abd El-Raouf (2001)**, **El-Gendy et al., (2001)** and **El-Yazal, et al., (2005)** on *Ocimum basilicum* L. and **Mohamed and Matter (2001)** and **Somida (2002)** on *Tagetes minuta* L.

Table (4) recorded that, volatile oil yield per plant was significantly affected by interaction among the studied factors except the interaction between methods of propagation x organic levels, in the both cuts. The terminal cutting combined with organic manure gave the highest volatile yield per plant than the seedlings combined with organic manure in both cuts. The most effective treatments that gave the highest volatile oil yield per plant were the terminal cuttings combined the poultry manure that surpassed the other combined in both cuts.

3-Volatile oil yield of herb per feddan (Liter):

Table (4) clearly show that total volatile oil yield of herb per feddan as affected by different applied propagation methods, took almost the same trend observed for total volatile oil yield of herb per plant. Cultivated

Table 4

Ocimum basilicum L. plants with the cuttings resulted in highly significant promotion in the two cuts. Moreover, gradually significant increase in such product was observed due to the terminal cuttings the increase reached about 53.31 and 31.15 % in the first and second cuts, respectively over the seedlings

The obtained results in Table (4) also revealed that the main effect of organic manure fertilization on the volatile oil yield of herb per feddan was statistically significant. All used poultry manure significantly surpassed the farm yard manure treatment in the two cuts by rate 4.18 and 3.31 %. These results took the same trend with **Mohamed and Matter (2001)** and **Somida (2002)** on *Tagetes minuta* L. and **Sakr (2001)** on *Mentha piperta* L.

Organic manure rates took almost the same trend observed for total volatile oil yield of herb per plant. Volatile oil yield per feddan significantly increased over control plants by 15.81, 41.54 and 48.16; 14.97, 37.70 and 43.05 %, respectively in both cuts. In the meantime both medium 20 m³ fed. (PM), high rate 30 m³/fed. (PM) and high rate 30 m³/fed. (FYM) were statistically equal in producing significant volatile oil yield in the both cuts. So the highest values of volatile oil yield were obtained when *Ocimum basilicum* L. plants received organic manure at rates of 20 m³/fed. from poultry manure (PM) or high rate 30 m³/fed. from farm yard manure (FYM). These results are in agreement with the findings reported by **Abd El-Raouf (2001)**, **El-Gendy et al., (2001)** and **El-Yazal, et al., (2005)** on *Ocimum basilicum* L. and **Mohamed and Matter (2001)** and **Somida (2002)** on *Tagetes minuta* L.

The data listed in Table (4) show that volatile oil yield per feddan in the herb of *Ocimum basilicum* L. plants took almost the same trend observed for total volatile oil yield of herb per plant. It was significantly affected by interaction among the studied factors except the interaction between methods of propagation x organic levels, in the both cuts. The terminal cutting combined with organic manure gave the higher volatile oil yield per plant than the seedlings combined with organic manure in both cuts. The most effective treatments that gave the volatile oil yield per plant was the terminal cuttings combined the poultry manure which surpassed the other combined in both cuts.

4 – Photosynthetic pigments content (mg / 100g):

Table (5) reported that photosynthetic pigments (chlorophyll a, b and carotenoids) contents in the leaves significantly increased by applied propagation. Terminal cuttings increased chlorophyll a, b and carotenoids contents over the seedlings by 1.80 and 2.03; 5.44 and 6.43; 9.68 and 8.96 %, respectively in two cuts.

The same Table (5) show that application of organic manure significantly increased chlorophyll a, b and carotenoids contents of *Ocimum basilicum* L. in both cuts. Poultry manure surpassed the farm yard manure by 5.87 and 2.54; 8.11 and 3.52; 10.94 and 2.90 %, respectively in two cuts of chlorophyll a, b and carotenoids contents. The results are agreement with those obtained by **Mohamed and Matter (2001)** and **Somida (2002)** on *Tagetes minuta* L., **Matter and Mohamed (2001)** *Calendula officinalis* L., **Sakr (2001)** *Mentha piperta* L. and **Mohamed (2006)** on roselle.

Also, data in same Table (5) revealed that chlorophyll a, b and carotenoids contents was significantly affected by organic manure rates. Chlorophyll a, b and carotenoids contents significantly increased by treated

with poultry manure rates than farm yard manure in the same. The highest values of chlorophyll a, b and carotenoids content were obtained when *Ocimum basilicum* L. plants received organic manure at rates of 20 or 30 m³/fed from poultry manure (PM) and high rate 30 m³/fed. farm yard manure (FYM). These results are in agreement with the findings reported by **Abd EL-Raouf (2001)** and **El-Gendy et al., (2001)** on *Ocimum basilicum* L., **Mohamed and Matter (2001)** on *Tagetes minuta* L. and **Sakr (2001)** *Mentha piperta* L. plants.

Table (5) show that the terminal cuttings combined with organic manure gave the best chlorophyll a, b and carotenoids contents than the seedlings combined with organic manure in both cuts.

The most effective treatments that gave the best chlorophyll a, b and carotenoids content were terminal cuttings combined the poultry manure which surpassed the other combined in both cuts.

5– Mineral contents (N, P and K):

The result in Table (6) show mineral contents such as nitrogen, phosphorus and potassium percentages contents in the herb significantly increased by applied propagation. Terminal cuttings increased mineral contents (N, P and K) over the seedlings by 5.40 and 7.33; 7.09 and 10.40; 6.17 and 6.48 %, respectively in two cuts.

Table (6) show that application of organic manure significantly increased mineral contents (N, P and K) of *Ocimum basilicum* L. in both cuts. Poultry manure surpassed the farm yard manure by 7.04 and 8.87 ; 3.78 and 2.97; 5.68 and 7.66 %, respectively in two cuts of mineral contents (N, P and K). The results are agreement with those obtained by **Mohamed and Matter (2001)** on *Tagetes minuta* L., **Matter and Mohamed (2001)** *Calendula officinalis* L., **El-Yazal, et al., (2005)** on *Ocimum basilicum* L. and **Mohamed (2006)** on roselle plants.

Mineral contents (N, P and K) significantly increased by treated with poultry manure rates than farm yard manure. In the meantime both medium 20 m³/fed. (PM), high rate 30 m³/fed. (PM) and high rate 30 m³/fed. (FYM) were statistically equal in producing significant mineral contents (N, P and K) in the both cuts. So from economical sides the highest mineral contents (N, P and K) were obtained when *Ocimum basilicum* L. plants received organic manure at rates of 20 m³/fed. from poultry manure (PM) or high rate 30 m³/fed. from farm yard manure (FYM).

Table (6) reported that the terminal cuttings combined with organic manure gave the best mineral contents (N, P and K) than the seedlings combined with organic manure in both cuts.

The most effective treatments that gave the best mineral contents (N, P and K) were terminal cuttings combined the poultry manure which surpassed the other combined in both cuts Table (6).

Table 5

Table 6

6 – Total carbohydrates content (mg/g D.W) :

Data in Table (7) clearly showed that total carbohydrates content gradually increased affected by different applied propagation methods. The maximum increases in total carbohydrates were obtained by cultivated with terminal cuttings and followed by the seedlings in both cuts.

Organic fertilization caused a significant increase in total carbohydrates content as shown in Table (7). The increase in such constituent was gradual and parallel to the fertilized by poultry manure than the farm yard manure. The results are agreement with those obtained by **Mohamed and Matter (2001)** on *Tagetes minuta* L., **Matter and Mohamed (2001)** *Calendula officinalis* L., **El-Yazal, et al., (2005)** on *Ocimum basilicum* L. and **Mohamed (2006)** on roselle plants.

The data listed in Table (7) showed that increasing the levels of organic fertilizers used in the study significantly increased the total carbohydrates content by 2.08, 5.98 and 7.01; 1.86 , 5.51 and 6.68%, respectively over control plants in both cuts. In the meantime both medium 20 m³/fed. (PM), high rate 30 m³/fed. (PM) and high rate 30 m³/fed. (FYM) were statistically equal in producing significant total carbohydrates content in the both cuts. So the highest values were obtained when *Ocimum basilicum* L. plants received poultry manure at rate of 20 m³/fed from poultry manure (PM) and high rate 30 m³/fed. farm yard manure (FYM). These results are in harmony with those reported by **Abd El-Raouf (2001)** and **El-Gendy et al., (2001)** on *Ocimum basilicum* L.

Table (7) reported that the terminal cutting combined with organic manure gave the best total carbohydrates content than the seedlings combined with organic manure in both cuts .

The most effective treatments that gave the best total carbohydrates content was terminal cuttings combined with poultry manure which surpassed the other combined in both cuts.

Table 7

In conclusion, it could be recommended to use terminal cuttings combined with poultry manure at rate of 20 m³/fed. or farm yard manure at rate of 30 m³/fed. to produce sweet basil plants having the tremendous growth rates and high volatile oil content in the same time to reduce the hazard of soil pollution as a result of using chemical fertilizers in agricultural production.

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تأثير طرق الإكثار والتسميد العضوي على النمو والمكونات الكيماوية لنبات الريحان الحلو

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أجريت تجربتان خلال موسمين متتابعين ناجحين هما ٢٠٠٥/٢٠٠٤م لدراسة تأثير طرق الإكثار بالشتلات الناتجة من البذرة والعقل الطرفية وباستخدام نوعين من السماد العضوي سماد بلدي و زرق الطيور بمعدلات صفر و ١٠ و ٢٠ و ٣٠م^٣ تم إضافتهم على دفعتين، الأولى قبل الحرث والثانية بعد الحشة الأولى وقبل العزيق على النمو والمكونات الكيماوية لنبات الريحان الحلو.

وتشير النتائج إلى:

- * أن صفات النمو مثل طول النبات، عدد الفروع للنبات، عدد النورات، الوزن الطازج للنبات، عدد الجذور، نسبة الزيت، محصول الزيت للنبات والفدان، محتوى النبات من النتروجين والفسفور والبوتاسيوم والمحتوى الكلى من الكربوهيدرات. زادت بمعنوية باستخدام طريقة الإكثار بالعقلة والتسميد بسماد زرق الطيور.
- * أعلى نتيجة تم الحصول عليها باستخدام التسميد بزرق الطيور بمعدل ٢٠ م^٣ / ف أو السماد البلدي بمعدل ٣٠ م^٣ / ف.
- * الإكثار بالعقل الطرفية مع التسميد العضوي أعطى أحسن نتيجة من الإكثار بالشتلات الناتجة من البذرة مع التسميد العضوي.
- * الإكثار بالعقل الطرفية مع التسميد بزرق الطيور أعطى أحسن نتيجة من التفاعلات الأخرى
- * كانت أعلى زيادة في صفات النمو التي تم دراستها في هذه الدراسة وأيضاً المحصول ومكوناته نتيجة استخدام الإكثار بالعقل الطرفية مع التسميد بزرق الطيور بمعدل ٢٠ م^٣ / ف أو مع السماد البلدي بمعدل ٣٠ م^٣ / ف.