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EFFECT OF ORGANIC FERTILIZER AND EGYPTIAN ROCK PHOSPHATE ON THE GROWTH, CHEMICAL COMPOSITION AND OIL PRODUCTION OF TARRAGON (*Artemisia dracunculus,* L.*)*

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ABSTRACT

This study was carried out during the two successive seasons of 2004 and 2005, to investigate the response of tarragon (Artemisia dracunculus) plants to fertilization using different levels of Egyptian rock phosphate (ERP) at rates of 0, 25 or 50 kg/fad/season, and/or cattle manure (CM) at rates of 0, 20, 40 or 60 m^3/ faddan/ season. The results showed that although all the applied treatments improved the growth and yield parameters of tarragon, Egyptian rock phosphate (ERP) at 50 kg/fed., combined with cattle manure (CM) at 40 m^3/feddan proved to be the best treatment in increasing the fresh and dry herb yields (per plant and per faddan), as well as the oil percentage and oil yield. Application of ERP at 25 kg/fed., combined with CM at 40 m^3/feddan gave the highest content of limonene in the essential oil, and decreased the estragole (which is an undesirable component) and anethol contents, compared to the control. The different CM treatments had a favourable effect on oil quality, by decreasing the estragole content. All the tested fertilization treatments tended to increase the contents of total carbohydrates in the herb. Among the three cuts harvested each season, the second cut gave the highest values for herb yield, oil percentage, oil yield, as well as the chemical parameters.

Keywords: Tarragon, *Artemisia*, rock phosphate, cattle manure, estragole, fertilization.

INTRODUCTION

Aromatic and medicinal plants are an important source of national income and foreign currency. They are among the most important agricultural export commodities that are in demand in European and other international markets. The *Asteraceae* (*Compositae*) is one of the largest and most highly evolved plant families, with a world-wide distribution of about 2500 genera and 25000 species. Artemisia is a large, diverse genus of plants with between 200-400 species belonging to the daisy family (*Asteraceae*). It comprises hardy herbs and shrubs known for their volatile oils. Tarragon (*Artemisia dracunculus*) is a perennial herb related to wormwood. Corresponding to its species name, a common term for the plant is "dragon herb." Tarragon is generally recognized as safe for human consumption as a natural seasoning/ flavoring and as a plant extract or essential oil. The different plant parts, as well as the essential oil, have several medicinal characteristics (ant scorbutic, diuretic, emmenagogue, hypnotic, stomachic, sedative, and in the treatment of indigestion, flatulence, nausea, hiccups, and menstrual problems). The herb is very useful in dealing with snake bites and bites from mad dogs. Also, it used in lotions and as a hair rinse, while the essential oil exhibits potent antifungal and antibacterial activities (Kordali *et al.,* 2005).

During the last years, medicinal and aromatic plants have been cultivated in newly reclaimed desert areas. Under such conditions, providing the cultivated plants with their nutritional requirements depends on the supply of macro-nutrients (including N, P and K), as well as micro-nutrients (including Fe, Mn and Zn) by the addition of organic and natural fertilizers. The importance of fertilization to medicinal plants was emphasized by Moe and Craker (1991), who stated that an adequate supply of nutrients, particularly N, is one of several factors responsible for increasing the oil yield. Also, the importance of fertilization was pointed out by Devlin (1975), who stated that the nutrients supplied by fertilization are necessary for the various biochemical processes that occur within the plant, and that are essential for normal plant growth and development.

The use of organic agriculture is spreading all over the world. Organic fertilizers are an important source for providing the plants with their nutritional requirements, and for alleviation of the problems of

chemical residues in the export commodities. Several researchers have investigated the nutritional requirements of a large number of aromatic plants, with the aim of determining the optimum fertilization treatments for maximum herb and oil production [Mohamed (2003) on periwinkle, Younis *et al*. (2004) on *Ammi visnaga*, Sakr (2005) on (*Cassia acutifolia*, Delile), Shaalan (2005, a) on *Nigella sativa*, and many others]. Organic fertilization is also one of the methods used to reclaim sandy desert land and to improve the chemical and physical characteristics of the soil.

Natural rock phosphate contains many of the micronutrients that are necessary for healthy plant growth and high productivity. It is also a source of the carbon necessary for providing plant energy, and which is needed by beneficial bacterial and microbial populations [Sastry *et al*. (1997) on *Chrysanthemum cinerariaefolium,* Haque and Lupwayi (1999) on *Trifolium tembense*]. Rock phosphates is also beneficial for acid soils because of its high calcium content that aids in neutralizing acidic soils.

For this reason, this investigation was conducted to determine the effect of cattle manure as an organic fertilizer, and Egyptian rock phosphate (ERP) as a natural source of phosphorus on the growth, oil yield and chemical composition of Tarragon (*Artemisia dracunculus* L.). The results of this study may help in optimizing the herb and essential oil yields as well as the oil quality and the chemical composition of the plants.

MATERIALS AND METHODS

This study was carried out in the farm of the Improved Agricultural Systems Project, Shark-Al-Bohayrat, Middle Sinai region (North Sinai Governorate), Ministry of Agriculture, during the two successive seasons of 2004 and 2005. The objective of the study was to investigate the effect of cattle manure (as an organic fertilizer) and Egyptian rock phosphate (ERP), as a natural source of phosphorus, on the growth, oil yield and chemical composition of tarragon (*Artemisia dracunculus* L.) plants.

The tarragon seedlings used in this study were obtained from the farm of Secum Co., El-Salam City, Cairo. On 25th March, 2004 and 2005 (in the first and second seasons, respectively), the seedlings were transplanted in hills (2 seedlings/hill) on rows, at a spacing of 100 cm between rows, and 50 cm between hills within the same row. The sandy soil contained 0.14% N, 0.15% P, 0.27% K, 0.82% Mg, 0.74% Ca, 3.11

ppm Fe, 0.66 ppm Mn, 0.54 ppm Zn, 0.39 ppm Cu and had an EC 0.90 ds/m.

In both seasons, the plants were fertilized using different combinations of Egyptian rock phosphate (ERP) and cattle manure (CM) application rates. Egyptian rock phosphate was applied at rates of 0, 25 or 50 kg/fad/season, while CM was applied at rates of 0, 20, 40 or 60 m^3/feddan/season. The cattle manure was obtained from the Animal Production Department, Faculty of Agriculture, Cairo University. The physical and chemical characteristics of the cattle manure are presented in Table (A). The above-mentioned rates of cattle manure were divided into two doses. The first dose was incorporated into the soil to a depth of 15-20 cm during soil preparation, two weeks before transplanting the seedlings (on 11th March 2004 and 2005, in the first and second seasons, respectively), while the second dose was applied after the first cut (on 30th June, 2004 and 2005 in the first and second seasons, respectively).

Egyptian rock phosphate (ERP), containing 20.5% P_2O_5) was tested as a source of phosphorus. It was obtained from "El-Ahram Company", El Talbia, Faisel St. area, El-Giza Governorate. The ERP treatments were added in one dose, which was incorporated into the soil to a depth of 15-20 cm two weeks before transplanting the seedlings, at the same time as the first dose of cattle manure.

The layout of this factorial experiment was a randomized complete blocks design, with three blocks (replicates) and 12 combinations of the two studied fertilizer types (3 CM rates X 4 ERP rates). Each block consisted of 12 rows (one row/treatment, with 10 hills / row).

Each season, three cuts were taken from the plants (on 30th June, 15th August and 30th September, 2004 and 2005 in the first and second seasons, respectively). At each cut, the plants were harvested by cutting the vegetative parts 10-15 cm above the soil surface.

In all cuts of the two seasons, data were recorded on herb fresh weight/plant (g), while herb dry weight/plant (g) was recorded after air-drying in a sunny area. The fresh and dry herb yields/faddan (ton) were calculated by multiplying the herb fresh and dry weights/plant, respectively, by the number of plants/faddan (8400 plants/faddan). Also, the oil percentage in the fresh herb was determined using the method described by the British Pharmacopoeia (1963). Satisfactory results were obtained by distillation of 100 g of fresh herb for 3 hours. The essential

oil yield per plant was calculated in proportion to the herb fresh weight/plant. The main constituents of tarragon essential oil were determined by subjecting oil samples (taken from the oil obtained in the second cut of the first season) to gas liquid chromatographically (GLC) analysis, as recommended by Hoftman (1967) and Bunzen *et al*. (1969). Also, dry herb samples were chemically analyzed to determine their total carbohydrates content (using the method described by Herbert *et al*., 1971).

Table A. Physical and chemical characteristics of the cattle manure used for fertilization of *Artemisia dracunculus* L. plants at 2004 and 2005 seasons.

Physical and chemical characteristics	Cattle manure (CM)	
	2004	2005
Weight of 1 m^3 (kg)	480	470
Moisture content (%)	8.06	8.70
Organic matter (%)	72.50	74.21
Organic carbon (%)	35.57	32.66
Total N (%)	1.74	1.83
C:N ratio	18.5 : 1	19.2 : 1
NH_3 - N (ppm)	53.7	58.3
NO_3 - N (ppm)	183.6	196.4
Total P (%)	0.35	0.51
Total K (%)	1.20	1.50
Fe (ppm)	1680.5	2010.5
Mn (ppm)	251.0	224.3
Zn (ppm)	157.2	148.6
Cu (ppm)	31.7	35.2

An analysis of variance (ANOVA) was conducted on the data recorded on fresh and dry herb yields per plant and per faddan, as well as the oil content and oil yield. The means were compared using the "Least Significant Difference (L.S.D.)" test at the 5% level, as described by Little and Hills (1978).

RESULTS AND DISCUSSION

I- Vegetative growth

1- Herb fresh and dry weights/plant

The results presented in Table (1, a & b) show that in the three cuts of the two seasons, plants receiving no rock phosphate had significantly lower herb fresh and dry weights/plant than plants supplied

with any of the rock phosphate fertilization treatments. Moreover, raising the rock phosphate application rate caused a steady increase in herb fresh and dry weights/plant. Accordingly, the maximum values were obtained from plants fertilized with the highest rate of rock phosphate (50 kg/fad.). The grand mean values recorded in both seasons for the effect of rock phosphate treatments confirmed the above conclusion. In both seasons, the lowest grand means for herb fresh and dry weights/plant were recorded in plants receiving no rock phosphate treatment, whereas the highest means were those of plants supplied with the highest rate of rock phosphate (50 kg/fad.). These results are in harmony with those reported by Garcia *et al.* (1997) on *Phaseolus vulgaris* cv. Cc-25-9N and Haque and Lupwayi (1999) on *Trifolium tembense* (clover).

The data in Table (1, a & b) also show that the cattle manure (CM) treatments had a considerable effect on the herb fresh and dry weights/plant. In all cuts of the both seasons, application of the different CM treatments gave significantly higher herb fresh and dry weights/plant than the control. Moreover, raising the CM application rate caused a gradual increase in herb fresh and dry weights/plant, with the highest CM rate (60 m^3/fed.) being the most effective treatment in this respect. This CM rate gave the highest herb fresh and dry weights/plant in all cuts of the two seasons. The grand mean values recorded for the effect of CM treatments on herb fresh and dry weights/plant in the two seasons showed a similar trend. In both seasons, the calculated grand mean values were increased steadily with raising the CM application rate. Accordingly, the highest grand mean values were obtained with the highest CM application rate (60 m^3/fad.). These results are in agreement with the conclusions reached by Sakr (2005) on *Cassia acutifolia,* Shaalan (2005, b) on *Borago officinalis* and Salim (2006) on *Salvia officinalis*.

The generally superior effect of organic manures on vegetative growth may be attributed to their effects on the soil, such as improving some of its chemical and physiochemical properties, thus improving water use efficiency [Wallace (1994 a)], preventing salt injury to plants that sometimes results from concentration of chemical fertilizers through the buffering properties of organic matter (Wallace, 1994 b), and providing the soil with essential macro and micronutrients (Awad *et al*., 1993). Also the addition of manures to the soil increases its cation exchange capacity (CEC) due to the ability of the negatively charged

organic matter particles to attract and hold the positively charged cations in the soil, and to provide the plant roots with these cations. Moreover, the addition of manures to the sandy soil increases the soil's water-holding capacity which, in turn, allows higher absorption of water and nutrients from the soil, and enables photosynthesis to occur efficiently within the plant leaves (Hartmann *et al*., 1981).

Regarding the interaction between the effects of ERP and CM treatments on herb fresh and dry weights/plant, it is clear from the data in Table (1, a & b) that in all cuts of the two seasons, plants receiving most of the ERP and CM treatment combinations gave significantly higher values than untreated control plants. In all cuts of both seasons, the highest herb fresh and dry weights/plant were those of plants supplied with ERP at the rate of 50 kg/fad., combined with CM at 40 m^3/fad., followed by plants fertilized using a combination of ERP at 50 kg/fad. and CM at 60 m^3/fad. On the other hand, the lowest herb fresh and dry weights/plant were those of plants receiving no rock phosphate or CM treatments.

The general increase in the herb fresh and dry weights as a result of the different fertilization treatments can be explained by the important roles played by the different nutrients (especially N, P, K) in the different physiological processes within the plant, which in turn affect plant growth.

Nitrogen is present in the structure of protein molecules, while phosphorus is as essential constituent of nucleic acids and phospholipids, and potassium is essential as an activator for enzymes involved in the synthesis of certain peptide bonds (Devlin, 1975).

In both seasons, the herb fresh and dry weights/plant recorded in the second cut were generally higher than those recorded in the first and third cuts. This may indicate that seasonal variations in environmental conditions had a considerable effect on the rate of vegetative growth of tarragon plants and/or that the first cut taken from the plants led to an increase in branching and, consequently, the formation of a larger foliage (which was taken in the second cut). However, the reduction in the values recorded in the third cut (compared to the second cut) suggests that the effect of unfavourable environmental conditions was greater than that of the increase in branching after the second cut.

2- Herb fresh and dry yields/ faddan

As might be expected, the effect of the applied treatments on the herb fresh and dry yields/ faddan (Table 2, a & b) was generally similar to their

effect on the herb fresh and dry weights/plant. In both seasons, plants supplied with ERP, CM, or their combinations gave significantly heavier herb fresh and dry yields, compared to those of unfertilized plants (control). Among the different ERP rates, the highest one (50 kg/fad.) gave the highest mean values for these two parameters. These results are in harmony with those obtained by Sharma *et al.* (1995) on *Camellia sinensis*, and Bielders *et al.* (1998) on cowpea.

Also, CM was most effective when applied at the highest rate (60 m^3/ad.), which gave the highest mean values in all cuts of the two seasons. These conclusions are in agreement with the findings of El-Gendy *et al.* (2001) on *Ocimun basilicum*, and Mohsen (2002) on *Ocimum basilicum*.

It could also be noticed that the highest herb fresh and dry yields/faddan, in all cuts of both seasons, were those resulting from fertilization with ERP at the rate of 50 kg/fed., combined with CM at 40 m^3/fed., followed by values resulting from fertilization using a combination of ERP at 50 kg/fed. and CM at 60 m^3/fad. Similar increases in dry herb yield /fed as a result of fertilization treatments have been reported by Zaharah and Bah (1997) on sweetcorn cv. Manis Madu. As observed for the herb fresh and dry weights/plant, the data in Table (2, a & b) also show that the herb fresh and dry yields/faddan were generally higher in the second cut than the first and third cuts.

II- Essential oil production

1- Essential oil percentage

The data in (Table 3) clearly show that the essential oil percentage in the fresh herb of tarragon was significantly increased following application of the different ERP fertilization treatments. In all cuts of the two seasons, supplying the plants with ERP at 50 kg/fed. gave significantly higher oil percentages, compared to the control plants. A similar trend was detected for the effect of ERP treatments on the grand mean values recorded for the essential oil percentage.

The results recorded in all cuts of the two seasons (Table 3) also show that CM fertilization was generally most effective in increasing the essential oil percentage (as well as the grand mean value for the three cuts) when it was applied at the highest rate (60 m^3/fed.). The increase in the essential oil content of plants fertilized with CM, compared to the

control, is in agreement with the results obtained by El-Ghadban (1998) on *Mentha viridis* and *Origanum majoranum*, Jacoub (1999) on *Ocimum basilicum* and *Thymus vulgaris,* Lalramthara *et al.* (2001) on ginger cv. Nagaland, Gouda (2002) on *Tagetes erecta*, Mohsen (2002) on *Ocimum basilicum,* El-Ghadban *et al.* (2003) on *Origanum majoranum*, and Salim (2006) on *Salvia officinalis.*

It is also evident from the results in (Table 3) that the interaction between the effects of ERP and CM on the oil content in the fresh herb, was significant in all cuts of both seasons. Plants receiving ERP at 50 kg/fed., combined with CM at 40 m^3/fed., had the highest oil percentage in their leaves.

2- Essential oil yield/plant

It is clear from data in (Table 4) that fertilization of tarragon plants with ERP enhanced the synthesis and accumulation of essential oil, with most of the ERP treatments increasing the oil yield/plant in all cuts of the two seasons (as well as the grand mean for the three cuts), compared to the unfertilized plants. Fertilization with ERP was most effective in this respect when applied at the highest rate (50 kg/fed.).

A similar trend was detected with CM fertilization, which gave a higher oil yield/plant when applied at the highest rate (60 m^3/fed.), compared to values obtained from control plants, or from plants receiving lower CM rates. The above results are in agreement with those obtained by El-Ghadban *et al*. (2003) on *Origanum majoranum*, Shaalan (2005 a) on *Nigella sativa* and Salim (2006) on *Salvia officinalis*.

Regarding the interaction between the effects of ERP and CM on oil yield /plant, the data in Table 4 show that the highest oil yield /plant was obtained from plants fertilized using ERP at 50 kg/fad., combined with CM at 40 m^3/fad., followed by plants fertilized with ERP at 50 kg/fed. plus CM at 60 m^3/fad.

3- Essential oil yield/faddan

The results recorded in the two seasons (Table 5) show that the effect of the different fertilization treatments on the oil yield/faddan followed a similar trend as their effect on the oil yield/plant. In all cuts of the two seasons, the different fertilization treatments increased the oil yield/faddan significantly, compared to the control. Fertilization using

ERP was most effective in this respect when applied at the highest rate (50 kg/fad.). The results recorded in all cuts of the two seasons (Table 5) also show that CM fertilization was generally most effective in increasing the oil yield/faddan when it was applied at the highest rate (60 m^3/fad.). The above results are in agreement with those obtained by Mohsen (2002) on *Ocimum basilicum.*

It is evident from the results in (Table 5) that the interaction between the effects of ERP and CM on the oil yield/faddan was significant (in all cuts of). In both seasons, plants fertilized with ERP at 50 kg/fad., combined with CM at 40 m^3/fad. gave the highest oil yield/faddan.

4- Essential oil components

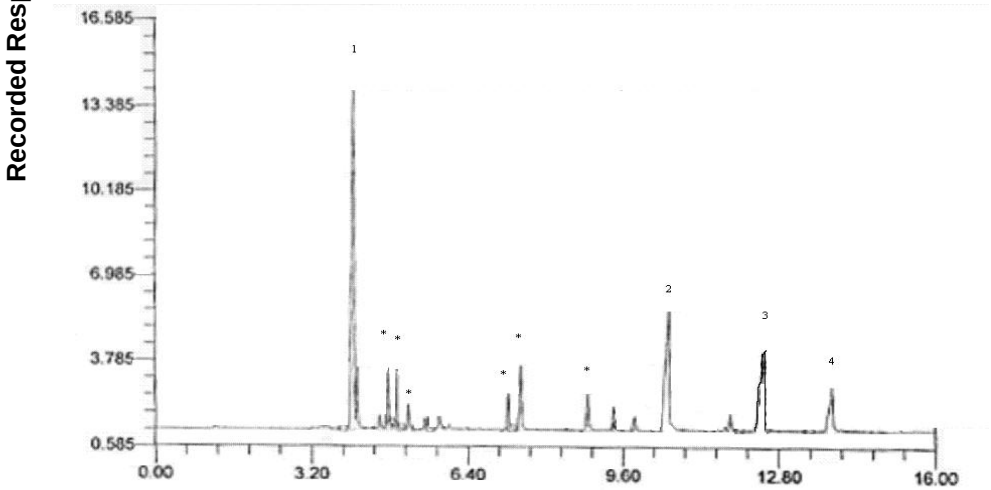
Chromatographic analysis of oil samples extracted from tarragon plants in the second cut of the first season (Table 6) showed that limonene was the most important essential oil component (with contents of 12.999-34.737%), followed by the undesirable component estragole (with contents of 7.115-25.093%), then anethol (with contents of 8.075-17.722%), whereas in most cases, ocimene was found at lower percentages (3.938-8.239%). It could be seen from the data in [(Table 6) and (Figure 1)] that ERP was most effective in increasing the limonene content when it was applied at the rate of 25 kg/fad., but this treatment also increased the estragole content. On the other hand, all CM treatments had a favourable effect on oil quality, as they decreased the estragole content, compared to the control. Plants fertilized with CM at 60 m^3/fad. had a higher limonene content than plants receiving lower CM rates. The combinations between ERP at 25 kg/fad. and all CM treatments gave higher limonene contents than treatment combinations which included application of ERP at 0 or 50 kg/fad. (regardless of the CM rate), while all the combinations of ERP and CM treatments gave lower estragole contents, compared to the unfertilized control plants.

(A)

B)

1-Limonene
2-Estragole
3-Anethol
4-Ocemene
***Unidentified**

Figure 1. G.L.C chromatogram of the essential oil of tarragon (*Artemisia dracunculus* L.)



plants receiving no fertilization (A), or fertilized with a combined between 25 kg/fad. of ERP and CM at 40 m^3/fad.

III- Herb chemical composition

1-Total carbohydrates content

It could be noticed from the data in (Table 7) that in all cuts of the two seasons, raising the rock phosphate application rate caused a steady increase in the total carbohydrates content. Accordingly, the highest values were obtained from plants fertilized with the highest rate of rock phosphate (50 kg/fad.).

The data in (Table 7) also show that the cattle manure (CM) treatments had a considerable effect on the total carbohydrates content of tarragon plants. In all cuts of both seasons, raising the CM application rate caused a gradual increase in total carbohydrates content, with the

highest CM rate (60 m^3/fad.) being the most effective treatment in this respect. These results are in agreement with the conclusions reached by Mohamed (2003) on periwinkle, Sakr (2005) on *Cassia acutifolia,* Delile, and Salim (2006) on *Salvia officinalis.*

It is also clear from the data in (Table 7) that in all cuts of both seasons, plants receiving most of the ERP and CM treatment combinations had higher total carbohydrate contents than untreated control plants. The highest total carbohydrates content was that of plants supplied with ERP at the rate of 50 kg/fad., combined with CM at 40 m^3/fad.

This general increase in the total carbohydrates content of plants fertilized with CM (compared to the control) can be easily explained, since the nitrogen supplied by the organic fertilizer is essential in the structure of prophyrines, which are found in the cytochrome enzymes essential in photosynthesis. This increase in the cytochrome enzymes results in an increase in the rate of photosynthesis, and a promotion in carbohydrate synthesis and accumulation. Moreover, the potassium added by fertilization acts as an activator for several enzymes involved in carbohydrate metabolism (Devlin, 1975).

Conclusively, although all the applied treatments improved the growth and yield parameters of tarragon, the combination of ERP at the rate of 50 kg/fed. plus CM at 40 m^3/fad. proved to be the best treatment in increasing the herb fresh and dry weights/plant, fresh and dry herb yields/faddan, as well as the oil percentage and oil yield/plant, followed by combining ERP at 50 kg/fad. with CM at 60 m^3/fad.

REFERENCES

Awad, F.; Khalil, K.W. and Maksoud, M.A. (1993). Comparative effects of some organic manures and bentonite as soil amendments. *Agrochemica,* **37** (6): 369-387. (Soil and fertilizers, **58**: 2948).

British Pharmacopoeia (1963*).* *Determination of Volatile Oils in Drugs*. The Pharmaceutical Press, 17 Bloomsbury Square, London, WC1. 220-222.

Bunzen, J. N.; Guichard, J.; Labbe, P.; Prevot, J.; Sperpinet, J. and Tranchant, J. (1969). *Practical Manual of Gas Chromatography.* Journal Tranchant, Ed., El-Seivier Publ. Co., Amesterdam – London. 189-206.

Devlin, R.M. (1975). *Plant Physiology*. 3rd Ed., Affiliated East-West Press Pvt. Ltd., New Delhi.

El-Gendy, S. A.; Hosni, A. M.; Ahmed, S. S.; Omer, E. A. and Reham, G. A. (2001). Variation in herbage yield, essential oil yield and oil composition of sweet basil (*Ocimum basilicum* L.var. "Grand Vert") grown organically in a newly reclaimed land in *Egypt. Journal of Agriculture Science, , Arab University* , **9**(2): 915-933. (Hort. Abst**.,** **72**: 5924).

El-Ghadban, E. A. E.; Ghallab, A. M. and Abd-El-Wahab, A. F. (2003). Effect of organic fertilizer and biofertilization on growth, yield and chemical composition of marjoram plants under newly reclaimed soil conditions. *Journal of Agriculture Science, Mansoura University*, **28**(9): 6957-6973.

Garcia, A.; Nuviola, A. and Aguilera, M. (1997). Evaluation of natural and modified rock phosphate from the Trinidad de Guedes deposits. *Agrotecnia de Cuba,* **27**(10): 50-54.

Hartmann, H.T.; Flocker, W.J. and Kofranek, A.M. (1981). *Plant Science Growth, Development, and Utilization of Cultivated Plants*. Prentice-Hall, Inc., Englewood Cliffs, N.J., USA, 178-179.

Haque, I. and Lupwayi, N. Z. (1999). Responses of clover and desmodium to Egyptian rockphosphate in Ethiopia. *Tropical Agriculture***, 76**(17): 109-113.

Hoftman, E. (1967). *Chromatography*. Reinhold Publ. Corp., 2nd Ed., 208-515.

Kordali, S., Kotan, R.; Mavi, A.; Cakir, A.; Ala, A. and Yildirim, A. (2005). Determination of the chemical composition and antioxidant activity of the essential Oil of *Artemisia dracunculus* and of the Antifungal and Antibacterial Activities of Turkish *Artemisia absinthium, A. dracunculus, Artemisia santonicum*, and *Artemisia spicigera* Essential Oils. *Journal of Agriculture Food Chem*., **53** (24): 9452 -9458.

Little, T. M. and Hills, F. J. (1978). *Agricultural Experimentation - Design and Analysis*. John Wiley and Sons, Inc., 53-60, 63-56.

Moe, Z. and Craker, L. (1991). Photosynthesis and the production of herbs. *The Herbs, Spice and Medicinal Plant Digest*, **9** (2): 15-18.

Mohamed, M. A. (2003). Taxonomical and physiological studies on periwinkle plants. Ph. D. Thesis, Faculty of Agriculture, Cairo University, Egypt.

Mohsen, M. M. A. (2002). Sweet basil herb and oil production as affected by chemical and organic fertilization. M.Sc. Thesis, Faculty of Agriculture, Cairo University, Egypt.

Sakr, W. R. A. S. (2005). Effect of organic and bio-fertilization on growth and active constituents production of senna plants. Ph.D. Thesis, Faculty of Agriculture, Cairo University, Egypt.

Salim, E. M. A. L. (2006). Effect of chemical, organic fertilizers and spraying with active dry yeast on growth, oil production and plant constituents of sage (*Salvia officinalis* L.) plants. M.Sc. Thesis, Faculty of Agriculture, Cairo University, Egypt.

Sastry, K. P.; Kumar, D.; Saleem, S. M. and Radhakrishnan, K. (1997). Effect of phosphorus on growth of pyrethrum plants *(Chrysanthemum cinerariaefolium)* and on flower yields. *Pyrethrum Post*, **19**(8): 132-138.

Shaalan, M. N. (2005 a). Influence of biofertilizers and chicken manure on growth, yield and seed quality of *(Nigella sativa* L.*)* plants. *Egyptian Journal of Agriculture Science, Mansoura University*, **17**(6):5223-5230.

Shaalan, M. N. (2005 b). Effect of compost and different sources of biofertilizers on borage plants *(Borago officinalis* L.). *Egyptian Journal of Agriculture Science, Mansoura University*, **17**(6): 5327-5335.

Sharma, D. K.; Sharma, K. L.; Sharma, C.M. and Bhardwaj, S. K. (1995). Effect of different phosphorus sources on yield and quality of tea (*Camellia sinensis*) in a hill acid soil. *Indian Journal of Agriculture Science,* **65** (9): 574-577.

Wallace, A. (1994, a). Soil organic matter is essential to solving soil and environmental problems. *Communications in Soil Science and Plant Analysis,* **25** (1-2): 15-28. (Soil and Fertilizers, **58**: 4876).

Wallace, A. (1994, b). Ten reasons why organic growers do not use synthetically compounded fertilizers. *Communications in Soil Science and Plant Analysis,* **25** (1-2): 125-128. (Soil and Fertilizers, **58**: 4264).

Younis, S.I.; Ghaly, N. G. and Ahmed, S. K. (2004). Effect of FYM and planting space on the vegetative growth, active ingredient and

chemical composition of *(Ammi visnaga* L.*)* plants. *Journal of Agriculture Science, Mansoura University*, **29**(4): 1985-1993.

Zaharah, A.R. and Bah, A.R. (1997). Effect of green manures on P solubilization and uptake from phosphate rocks. *Nutrient Cycling in Agroecosystems*., **48** (50):247-255.

تأثير التسميد العضوى و صخر الفوسفات المصرى على النمو والتركيب الكيماوي وإنتاج الزيت في نبات الطرخون

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* قسم بساتين الزينة- كلية الزراعة- جامعة القاهرة. - ج.م.ع.

** قسم بحوث النباتات الطبية و العطرية- معهد بحوث البساتين- مركز البحوث الزراعية- وزارة الزراعة- القاهرة.- ج.م.ع.

أجريت هذه الدراسة في الموسمين المتتاليين ٢٠٠٤ و ٢٠٠٥، لدراسة تأثير كل من التسميد العضوي (باستخدام سماد الماشية) بمعدلات ٢٠، ٤٠ أو ٦٠ م^{٣}/فدان/موسم، أو صخر الفوسفات المصرى بمعدلات ٢٥ أو ٥٠ كجم/فدان/موسم على النمو و التركيب الكيماوي و إنتاج الزيت فى نبات الطرخون.

وأوضحت النتائج انه رغم أن كل المعاملات المستخدمة قد أدت الى تحسين قياسات النمو والمحصول لنبات الطرخون الا أن الجمع بين المعاملة بسماد الماشية بمعدل ٤٠م^{٣}/فدان، وإضافة صخر الفوسفات المصري بمعدل ٥٠ كجم/فدان كانت أفضل المعاملات فى زيادة وزن ومحصول العشب الطازج والجاف لكل من النبات والفدان.، وكذلك النسبة المئوية للزيت فى العشب الطازج ومحصول الزيت المتحصل عليه من النبات. هذا وقد تم الحصول على أعلى القيم لمحتوى الليمونين عند الجمع ما بين التسميد بسماد الماشية بمعدل ٤٠م^{3}/فدان والتسميد بصخر الفوسفات المصري بمعدل ٢٥كجم/فدان، كما خفضت هذه المعاملة محتوى الأسترجول (وهو مكون غير مرغوب) والأنيثول، عن معاملة المقارنة. وكان لمعاملات سماد الماشية المختلفة تأثير جيد على نوعية الزيت حيث قللت من محتوى الأسترجول. كذلك فإن المعاملات السمادية المختلفة أدت ألى زيادة المحتوى الكلى للكربوهيدرات فى العشب. وسجلت أعلى القيم بالنسبة الى محصول العشب الطازج والجاف ومحتوى الزيت ومحصول الزيت وكذلك الصفات الكيماوية خلال الحشة الثانية لكلا الموسمين.