Effect of Some Fertilizers Types and Drip Irrigation Rates on Productivity of *Matricaria chamomilla* L. Plant Under El-Arish Region Conditions

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Abstract: *This work aimed to study the combined effect of fertilizers types (chemical fertilization, composted olive cake, farmyard manure and their combination) and irrigation rates (467, 933 and 1400 m^3/fed.) on the growth, yield of both inflorescences and volatile oil and some chemical constituents of chamomile plants during the first season 2003/2004(less rainy) and second season 2004/2005 (rainy). The obtained results showed that, under the conditions of North Sinai (El-Arish region), increasing drip irrigation rates from 467 to 1400 m^3/fed. during the second (rainy) season combined with NPK fertilizers (300, 300 and 100 kg/fed. from ammonium sulphate, calcium superphosphate and potassium sulphate, respectively) plus farmyard manure resulted in 60.0% increase in inflorescences dry yield/fed. and 71.2% in volatile oil yield more than the same treatments during the first (less rainy) season. However, increasing irrigation rate during the first season to 1400 m^3/fed. gave economic yields of dry inflorescences and volatile oil. The highest irrigation rate combined with NPK fertilizers plus farmyard manure (30m^3/fed.) appeared to give the adequate balance of nitrogen, phosphorus, potassium and total carbohydrate percentages in herb. The water use efficiency was at the highest significant value during the second (rainy) season under the highest irrigation rate (1400 m^3/fed.) and NPK fertilizers plus farmyard manure fertilizer.*

Key words: *Fertilization, composted olive cake, farmyard manure, inflorescences, volatile oil and water use efficiency.*

INTRODUCTION

Chamomile plants (*Matricaria chamomilla* L) belong to Fam. *Compositeae* (*Asteraceae*).The local production of flowers during the winter and early months of spring gives the crop great worldwide advantage. There is a need for increase its productivity to meet the increament in export, which may be achieved by increasing the cultivated area through cultivation in newly reclaimed sandy soil at El-Arish by using the drip irrigation system or rainfall water.

As for the rain precipitation is not always constant, the needed irrigation rate must be determined to be enough taking into consideration the amount of rain fall, so the tested amount of applied drip irrigation water in this work was half of that normally applied in the dry area which have less water precipitation.

Sandy soils have their own problems as single grain structure, susceptibility to erosion, low levels of nutrients and microorganisms (Nour, 1999). Therefore, adding organic manures to sandy soil would improve their phsico-chemical and biological properties which increase soil organic matter, cationic exchange capacity, available nutrients and this in turn stimulates plant growth and productivity.

In El-Arish, the prices of organic manures, i.e., farmyard manure are expensive and they are considered a source of infection by various diseases and carrying weed seeds.

Therefore, the objective of the present work was to study the possibility of using a local organic manure product (composted olive cake) which is available in a low price and free from diseases and weed seeds.

Many studies had been published on effect of fertilization on chamomile plants, Saleh (1962) on chamomile reported that the different treatments of fertilization greatly affected the number of flower heads per plant, as well as, the yield of flower heads of individual plants. Agena (1975), Kandeel (1982) and Mohamed (1988) working on *Matricaria chamomilla* showed that oil percentage and yield increased with increasing the dose of nitrogen. Also, Jolivet (1977) on Roman chamomile (*Anthemis nobilis*) mentioned that NPK application gave the highest yield of essential oil.

Also, Emongor and Chweya (1992) found that N fertilization (up to 150 mg/pot) significantly increased the oil yield/unit flower DW in both cultivars of *Matricaria chamomilla* and *Matricaria recutita*. Johri *et al.* (1992) on *Matricaria recutita* concluded that N application at 60 kg/ha increased flower and oil yields as well as oil content. Essa (1999) on chamomile indicated that the fresh and dry weights of the flowers heads increased for the plants received high soil fertilizer (400+400+100 kg/fed) of ammonium nitrate, calcium super phosphate and potassium sulphate respectively.

Concerning organic fertilization on chamomile plant, Gindich and Sheberstov (1969) found that addition of 20 t/ha of organic fertilizers raised the yield of chamomile flowers by 51% at new reclaimed sandy soil.

Using poultry manure, chemical fertilization and drip irrigation could be conserved the limited water resources and to increase water use efficiency, Kamel-Dawh *et al.* (2002) on *Matricaria chamomilla* L., in sandy soil, found that irrigation rate to 2802 m^3water/fed./season (126 l/plant/ season) combined with NPK (300, 300 and 100 kg /fed. of ammonium sulphate, calcium superphosphate and potassium sulphate, respectively) plus 20 m^3/fed. poultry manure

increased inflorescences yield compared to 934 m^3 water /fed. /season (42 l/plant/season).

There is no doubt that chemical fertilizers are essential in most cropping systems if maximum yield are to be realized. However, application of mineral fertilizers in long term causes some problems especially environmental pollution and public health risk (Top *et al.* 2002). So, application of organic manure can be used as an environment and reduce the pollution of underground water.

The literature on the effect of organic residues and chemical fertilization treatments under rain conditions in sandy soil on chamomile plants characters not known. So, the present study was carried out to investigate the effect of composted olive cake in comparison with other manures and chemical fertilization with three irrigation rates on the vegitative growth, flowers production and oil yield of *Matricaria chamomilla* L. plants under El-Arish region and rain conditions.

MATERIALS AND METHODS

This study was carried out during the two successive winter seasons of 2003/2004 and 2004 /2005 in the Experimental Farm of Fac. of Environmental Agric. Sciences, El-Arish, North Sinai Governorate, under sandy soil conditions using drip irrigation system to study the effect of chemical fertilization, composted olive cake and farmyard manure combined with irrigation water quantities during less rainy and rainy seasons on growth, inflorescences yield, volatile oil yield and some chemical constituents in herb as well as water use efficiency of chamomile plants.

The seeds of *Matricaria chamomilla* L. were sown in the nursery on October 1st, in both seasons of 2003 and 2004. Uniform seedlings about 10 cm lengths were transplanted on November 15th to the sandy soil. Drip irrigation system was used. The chemical analysis of soil and underground water used for irrigation were carried out using Atomic Absorption spectrophotometer according to Page (1982) and presented in Table A.

This experiment included 18 treatments which were the combination of 6 fertilizers types and three amounts of irrigation water. Fertilization treatments were randomly arranged in the main plots and irrigation amounts were randomly distributed in the sub plots.

Fertilizers Types

A) NPK fertilization was 300, 300 and 100 kg/fed. as ammonium sulphate (20.5%N), calcium super- phosphate (15.5%P_2O_5) and potassium sulphate (48%K_2O) respectively, as recommended by Kamel-Dawh *et. al.* (2002).

B) Composted olive cake (COC) 30m^3/fed.

C) Farmyard manure (FYM) 30m^3 /fed.

D) NPK (300, 300 and 100 kg/fed.) + COC (30 m^3/fed.),

E) NPK (300, 300 and 100 kg/fed.) + FYM (30 m^3/fed.),

F) NPK (300, 300 and 100kg/fed.) + COC (15m^3 /fed.) + FYM (15m^3 /fed.).

Irrigation Rates (m^3/fed.)

A) Irrigation time 15 minutes /7 days (equal 467 m^3/fed.),

B) Irrigation time 30 minutes/7days (equal 933 m^3/fed.), and

C) Irrigation time 45 minutes/7 days (equal 1400 m^3/fed.).

The experimental unit area was 10.8m^2. Every unit contained three dripper lines with 18m length each. The distance between lines was 60 cm and between drippers was 30 cm (between seedlings). Every experimental unit contained 60 plants (about 23333 plants /fed.).

The two organic manures were composted for three months before applying. During composting period, manures were wetted and mixed every two weeks. Farmyard manure (FYM) and local organic composted olive cake (COC) were applied at soil preparation in the row and covered with 10cm soil. The farmyard manure was obtained from Animal Production Farm, Fac. of Environmental Agric. Sciences, El-Arish, North Sinai. Pressed olive cake represents the majority of agro industrial by-products in El-Arish. There are about 35.000 ton olive product/ year and about 3000 ton pressed olive cake/year (Information Center of North Sinai Governorate, Agric. Dep. March 2000). The chemical fertilization was applied as soil dressing beside dripper. The amount of chemical fertilizer treatments were divided into six equal doses, the first dose was applied after one month from transplanting, whereas the other five doses were applied weekly. The chemical analyses of farmyard manure and composted olive cake are presented in Table B.

The irrigation treatments in the experiments started at 10 days after seedling and were added by seven days intervals (which equal 20 irrigates/season) in the morning. The water was added using water counter and time control with dripper discharge (4 l/h. at 1.0 bar.).

The rain quantities which were downward on El-Arish region during the first and second seasons and other meteorological are illustrated in Table C. The total amounts of rain m^3/fed./season = length of rain (mm)/1000 x 4200 m^2 = m^3/fed.

A random sample of three plants in the middle line from each plot was used for evaluating the data as the following: (A) Fresh and dry weights of herb, fresh and dry weights of yearly yield of inflorescences/plant (g) and dry yield of inflorescence (kg/fed.). (B) Oil percentage was determined in the dry flower heads by water distillation method according to the British Pharmacopoeia (1963). The mean of oil yield was calculated by multiplying oil percentage by the dry weight of flower heads. (C) Chemical analysis of samples of the herb of chamomile at the full flowering stage were taking and dried at 70°C and nitrogen,

Table A: Some characteristics of chemical analysis (soluble ions in 1:5 extract) of soil and underground water before conducting experiments

Chemical properties	Soil		Water
	First season 2003/2004	Second season 2004/2005	
Ca^{++} (meq./l^{-1})	3.03	2.10	18.12
Mg^{++} (meq./l^{-1})	2.11	2.20	20.20
Na^{+} (meq./l^{-1})	1.18	4.49	17.72
K^{+} (meq./l^{-1})	0.48	0.31	0.25
Cl^{-} (meq./l^{-1})	1.02	2.30	38.40
Co_3^{--} (meq./l^{-1})	-	-	-
Hco_3^{-} (meq./l^{-1})	2.00	2.40	6.25
So_4^{--} (meq./l^{-1})	3.78	4.40	11.64
EC. (dsm^{-1})	0.68	0.91	5.65
pH in (1:2.5 extract)	8.10	8.20	6.70
Organic matter (%)	0.16	0.21	-
$CaCO_3$ % in air dried soil	3.95	3.95	-

Table B: Chemical analysis of the used farmyard manure and composted olive cake

Organic manure source	N (%)	P_2O_5 (%)	K_2O (%)	Organic matter (%)
Farmyard manure	2.76	3.1	2.3	26.0
Composted olive cake	6.00	1.7	1.2	42.0

Table C: The meteorological data of El-Arish region during the first (2003/2004) and second (2004/2005) seasons*

Months	Temperature(°C)				R.H.%				Rain (mm/month)	
	First season		Second season		First season		Second season		First season	Second season
	Max.	Min.	Max.	Min.	Max	Min	Max	Min		
Nov.	24.3	11.4	25.3	14.0	99.6	66.5	97.0	60.3	1.5	64.5
Dec.	21.1	8.74	19.9	8.42	93.9	48.6	99.0	62.8	8.0	51.5
Jan.	17.0	7.30	20.5	8.0	100	67.0	99.0	56.0	6.0	44.5
Feb.	22.4	9.20	20.3	8.9	99.1	50.1	99.5	50.0	1.5	8.5
Mar.	22.4	10.9	22.9	11.0	97	59.0	96.0	61.0	10.5	28.0
Apr.	24.8	12.7	25.7	12.7	99	57.0	100	54.0	-	25.0
Total									27.5	222

*Cited from: Monthly Journal of Agric. Meteorological. Agric. Research Center, Ministry of Agriculture, A.R.E.

phosphorus, potassium and total carbohydrates were determined according to the method described by A.O.A.C. (1980), Hucker and Catroux (1980), Brown and Lilliland (1946) and Dubois *et al.*(1956), respectively. (D) Plant water use efficiency expressed as water economy was calculated using the following equation. Water economy = {[dry inflorescences yield (kg/fed.)] / [total amount of applied water (m^3/fed.)]} (kg/m^3).

The experimental design was factorial experiment with two factors; i.e., fertilization types and irrigation rates conducted with three replicates.

The obtained data were subjected to statistical analysis of variance according to Snedecor and Cochran (1980) and means separation were done according to Duncan (1958).

RESULTS

The Main Effect of Irrigation

Data in Tables 1 and 2 indicate that the highest irrigation rate (1400 m^3/fed.) resulted in the highest significant values of the fresh and dry weights of herb and inflorescences/plant and per fed. As the irrigation rate decreased to (467 m^3/fed.) parallel significant decrease in this value was recorded. On the contrary, oil percentage in the dried inflorescence decreased significantly with the high irrigation rate while significant increases in oil yield /plant and per fed. were clear in as irrigation rate increased. This was due to the significant increase in the dry yield of inflorescences rather than the effect of oil percentage.

It is worth that the mentioned characteristics recorded high values in the second season than the first one. This may be due to the high amounts of rain water during the second season since it was 222 mm against 27.5 mm for the first season. This amount of rain water in addition to applied irrigation rate (1400 m^3/fed.) raised the received amount of water to be 2332.4 m^3/fed. which resulted in the highest values for studied characters. In this concern the dry yield of inflorescences/fed. during the second season reached 871.4 kg/fed. against 529.1 kg/fed. during the first season.

Concerning the main effect of irrigation on total nitrogen, phosphorus, potassium and total carbohydrate percentages, it is clear from Tables 2 and 3 that the highest nitrogen percentage (4.13 %) was obtained with medium level of irrigation (933 m^3/fed.) during the second season while the least value (3.76 %) was belong to the least level of irrigation (467 m^3/fed.) during the first season. On the other side, a parallel significant increase in phosphorus, potassium and total carbohydrate percentages were recorded as irrigation level increased, where the highest values were recorded with the highest irrigation rate.

The Main Effect of Fertilization

Data in Tables 1 and 2 show the main effect of fertilization. It is clear that the highest fresh and dry weights of herb and inflorescences per plant as well as the dry weight of inflorescences/fed. were obtained from NPK fertilization plus FYM treatments, while the least values were recorded from using COC fertilization treatment alone. Also, similar trend was obtained concerning volatile oil percentage and yield/ fed.

The main effect of fertilization treatments on nitrogen, phosphorus, potassium and total carbohydrate percentages in the herb of chamomile plants in Tables 2 and 3 show that the highest total nitrogen percentage was obtained from using COC fertilization treatment (30 m^3/fed.) followed by using NPK + COC fertilization treatment, while FYM fertilization (30 m^3/fed.) alone showed the highest significant percentages of phosphorus and potassium. However, COC fertilization alone or combined with NPK fertilization were more effective in enhancing total carbohydrate percentage. The other treatments resulted in less total carbohydrate percentage.

The Interaction Effect

It is clear from Tables 4 and 5 that the highest fresh and dry weights of herb and dry weight of yearly yield of inflorescences/plant and per fed. were obtained during the second (rainy) season combined with the highest irrigation rate (1400 m^3/fed.) and fertilized with NPK plus FYM fertilization. On the contrary, the highest volatile oil percentages (0.68 and 0.67 %) were obtained during the second (rainy) season when combined with low and medium levels (467 and 933 m^3/fed., respectively) of irrigation and fertilized with NPK plus FYM treatments. The least volatile oil percentage (0.38 %) was obtained during the first (less rainy) season even received the highest irrigation rate and fertilized with COC. This meant that the less water emendation and using COC fertilization had a detrimental effect on volatile oil synthesis.

Data of Table 5 indicate that the highest volatile oil yield/fed. (7.36 l) was obtained during the second (rainy) season combined with the highest irrigation rate and fertilized with NPK plus FYM.

The interaction effect in Table 5 show that the highest total nitrogen percentage was recorded with medium irrigation rate during the second (rainy) season and combined with COC fertilization, while there was no significant effect for the interaction on phosphorus, potassium and total carbohydrates percentages, Table 6. As for using high irrigation rate (1400 m^3/fed.) during the rainy season, the data in Table 6 indicate that this rate of irrigation when combined with NPK fertilizers plus FYM proved to be efficacious in obtaining the highest water use efficiency.

DISCUSSION

The results of this work indicate the less rainy season (27.5 mm/season equal 115.5 m^3/fed.) decreased the vegetative growth and inflorescences yield even when combined with the used highest irrigation rate 1400 m^3/fed. comparing to the rainy season (222 mm/season equal 932.4 m^3/fed.). This indicates that using irrigation rate 1400 m^3/fed. without rainfall not less than 222 mm/season during growth period is not enough to produce adequate yield of chamomile plant.

Table 1: The main effect of fertilizers types and irrigation rates treatments on dry yield of inflorescence/fed., volatile oil percentage and yield/fed. as well as nitrogen percentage of chamomile plant during 2003/2004 and 2004/2005 seasons

Treatments	Fresh weight of herb (g/plant)		Dry weight of herb (g/plant)		Fresh weight of yearly yield of inflorescence (g/plant)		Dry weight of yearly yield of inflorescence (g/plant)	
	First season	Second season	First season	Second season	First season	Second season	First season	Second season
Fertilizers types								
NPK	129.94 c	192.35 d	21.95 c	25.75 d	53.98 d	82.48 e	12.44 c	18.92 d
COC	95.97 d	169.75 d	16.27 d	22.90 d	40.10 e	71.64 f	9.41 d	16.25 e
FYM	138.26 bc	226.59 c	23.75 c	30.20 c	55.82 c	98.61 d	12.61 c	22.41 c
NPK+COC	160.93 b	255.18 b	27.45 b	33.55 b	64.57 b	112.22 c	14.40 b	24.52 b
NPK+FYM	223.28 a	289.71 a	36.30 a	40.28 a	87.02 a	130.12 a	18.95 a	31.43 a
NPK+COC+FYM	213.93 a	276.48 ab	34.03 a	39.12 a	85.41 a	123.04 b	18.70 a	30.25 a
Irrigation rates (m^3/fed.)								
467	48.73 c	82.74 c	9.58 c	13.03 c	17.28 c	31.06 c	4.16 c	7.32 c
933	182.88 b	279.03 b	32.63 b	37.97 b	70.71 b	118.23 b	16.42 b	27.23 b
1400	249.55 a	343.11 a	37.66 a	44.90 a	105.46 a	159.77 a	22.67a	37.34 a

NPK= chemical fertilization, COC= compost olive cake and FYM=farm yard manure. Values heaving the same alphabetical letters did not significantly differ at 0.05 level of significance according to Duncan's multiple range tests.

Table 2: The main effect of fertilizers types and irrigation rates treatments on dry yield of inflorescence/fed., volatile oil percentage and yield/fed. as well as nitrogen percentage of chamomile plant during 2003/2004 and 2004/2005 seasons

Treatments	Dry yield of inflorescence (Kg /fed.)		Volatile oil (%)		Volatile oil yield (L/fed.)		Nitrogen (%)	
	First season	Second season	First season	Second season	First season	Second season	First season	Second season
Fertilizers types								
NPK	290.3 c	441.4 d	0.44 d	0.49 c	1.23 d	2.08 e	3.98 b	3.92 c
COC	219.6 d	379.3 e	0.42 d	0.47 d	0.88 e	1.72 f	4.99 a	5.14 a
FYM	294.3 c	522.9 c	0.54 c	0.57 b	1.57 c	2.91 c	3.58 d	3.18 e
NPK+COC	336.1 b	572.3 b	0.36 e	0.42 d	1.18 d	2.37 d	4.49 b	4.63 b
NPK+FYM	442.1 a	733.3 a	0.60 a	0.65 a	2.62 a	4.72 a	3.27 e	2.95 f
NPK+COC+FYM	436.5 a	706.0 a	0.54 b	0.58 b	2.34 b	4.09 b	3.74 c	3.53 d
Irrigation rates (m^3/fed.)								
467	97.2 c	170.8 c	0.52 a	0.56 a	0.52 c	0.99 c	3.88 c	3.76 b
933	383.1 b	635.5 b	0.47 b	0.52 b	1.87 b	3.41 b	4.13 a	4.02 a
1400	529.1 a	871.4 a	0.45 c	0.50 c	2.52 a	4.55 a	4.01 b	3.90 b

NPK= chemical fertilization, COC= compost olive cake and FYM=farm yard manure. Values heaving the same alphabetical letters did not significantly differ at 0.05 level of significance according to Duncan's multiple range tests.

Table 3: The main effect of fertilizers types and irrigation rates treatments on phosphorus, potassium, total carbohydrate percentages and water use efficiency of chamomile plant during 2003/2004 and 2004/2005 seasons

Treatments	Phosphorus (%)		Potassium (%)		Total carbohydrate (%)		Water use efficiency (kg/m^3)	
	First season	Second season	First season	Second season	First season	Second season	First season	Second season
Fertilizers types								
NPK	0.40 c	0.43 c	2.56 c	2.37 c	11.75 bc	11.48 cd	0.26 bc	0.22 c
COC	0.23 f	0.20 f	1.89 f	1.78 f	12.62 a	12.67 b	0.19 c	0.19 c
FYM	0.60 a	0.56 a	3.06 a	2.83 a	12.25 b	11.86 c	0.26 bc	0.26 c
NPK+COC	0.29 e	0.28 e	2.21 e	2.22 e	12.86 a	12.93 a	0.30 b	0.29 ab
NPK+FYM	0.50 b	0.51 b	2.81 b	2.60 b	11.59 c	11.00 f	0.38 a	0.37 a
NPK+COC+FYM	0.34 d	0.33 d	2.37 d	2.29 d	12.10 b	11.53 e	0.37 ab	0.35 ab
Irrigation rates (m^3/fed.)								
467	0.36 c	0.36 c	2.39 c	2.25 c	10.88 c	9.97 c	0.17 c	0.12 c
933	0.40 b	0.38 b	2.49 b	2.36 b	12.09 b	11.58 b	0.37 a	0.34 b
1400	0.42 a	0.42 a	2.57 a	2.43 a	13.61 a	14.18 a	0.35 b	0.37 a

NPK= chemical fertilization, COC= compost olive cake and FYM=farm yard manure. Values heaving the same alphabetical letters did not significantly differ at 0.05 level of significance according to Duncan's multiple range tests.

Table 4: Effect of interaction between fertilizers types and irrigation rates treatments on fresh and dry weights of herb/plant and fresh and dry of yearly yield of inflorescences/plant of chamomile plants during 2003/2004 and 2004/2005 seasons

Treatments	Irrigation rates (m^3/fed.)					
	467	933	1400	467	933	1400
Fertilizers types	First season			Second season		
	Fresh weight of herb (g/plant)					
NPK	38.64 g	161.30cd	189.88 c	50.28 h	248.13 e	278.64 d
COC	32.16 fg	113.60 e	142.16 d	46.18 h	219.60 f	243.47 ef
FYM	46.40 fg	172.15 c	196.24 c	72.13 gh	278.40 d	329.24 c
NPK+COC	53.48 fg	183.20 c	248.42 b	94.16 g	302.73 c	368.66 b
NPK+FYM	64.23 f	237.25 b	368.35 a	121.31 g	315.34 c	432.49 a
NPK+COC+FYM	57.77 fg	229.75 b	354.26 a	112.35 g	310.95 c	406.15 a
	Dry weight of herb (g/plant)					
NPK	7.43 h	28.05 e	30.38 de	8.19 k	34.65 f	34.40 f
COC	6.67 h	19.58 f	22.56 f	7.57 k	30.86 g	30.27 g
FYM	9.39 gh	30.20 de	31.65 d	11.44 j	38.43 e	40.74 gh
NPK+COC	9.59 gh	32.71 d	40.06 c	14.75 i	40.94 de	44.95 c
NPK+FYM	12.87 g	43.93 b	52.10 a	18.37 h	41.49 d	60.98 a
NPK+COC+FYM	11.55 g	41.32 bc	49.23 a	17.84 h	41.46 d	58.07 ab
	Fresh weight of yearly yield of inflorescence(g/plant)					
NPK	14.31 jk	64.00 g	83.64 e	18.32 p	101.3 j	127.8 g
COC	11.95 k	45.44 h	62.90 g	16.38 p	87.84 k	110.7 i
FYM	16.63 j	68.04 f	82.80 e	26.74 o	116.0 h	153.1 d
NPK+COC	18.99 ij	69.92 f	104.8 c	35.46 n	128.9 g	172.3 c
NPK+FYM	21.55 i	88.52 d	151.0 a	46.25 l	140.1 e	204.0 a
NPK+COC+FYM	20.27 i	88.36 d	147.6 b	43.21 m	135.2 f	190.7 b
	Dry weight of yearly yield of inflorescence(g/plant)					
NPK	3.43 hi	15.52 e	18.38 d	4.74 m	23.16 h	28.86 e
COC	2.86 i	11.41 g	13.97 f	3.78 m	20.16 i	24.83 g
FYM	4.00 hi	15.84 e	18.00 d	6.24 l	26.48 f	34.51 c
NPK+COC	4.58 h	16.09 e	22.54 b	8.24 k	29.55 e	35.79 c
NPK+FYM	5.23 h	19.84 c 19.82 c	31.78 a 31.40	10.85 j 10.07 j	32.58 d 31.47	50.86 a 49.23
NPK+COC+FYM	4.90 h		a		d	b

NPK= chemical fertilization, COC= compost olive cake and FYM= farmyard manure. Values heaving the same alphabetical letters did not significantly differ at 0.05 level of significance according to Duncan's multiple range test.

In this regard Abd-El-Moneim (1999) pointed that three supplementary irrigations gave the highest means of vegetative growth and yield characters of wheat plant when rainfall was 86.4 or 96.8 m^3/season in El-Arish district (North Sinai).

The obtained results could be assured by the previous work of Kamel- Dawh *et al.* (2002) on chamomile cultivated in El-Kassasin, Ismaillia Governorate in sandy soil where the rainfall were 8.7 and 5.6 mm/season equal 36.54 and 23.52 m^3/fed. during two seasons. The author found that increasing the irrigation rate to 1868 or 2802 m^3/fed. resulted in economical yield of dry inflorescences/fed. as 514.33 and 555.79 kg/fed., respectively. The highest irrigation rate used in the herein work was 1400 m^3/fed. it was half of that used in the previous work by Kamel-Dawh *et al.* (2002). So, it is clear that using 1400 m^3/fed. during the less rainy season is not enough, but it appear to be suitable when rainfall not less than 222 mm/season to obtain high yield of dry inflorescences as 529.1 and 871.4 kg/fed.(Table 2) during the first and second seasons, respectively as main effect of irrigation.

In the herein work the increase in fresh and dry weights of herb/plant and yearly yield of inflorescences/plant and per fed. by increasing the irrigation levels could be explained by either increasing the number of cell layers in the cell expanding zone and cambial zone according to high level of irrigation, or as a result of water availability that increased cell division as mentioned by Abe and Nakai (1999). Moreover, Kozlowski (1971) concluded that internal water stress influences shoot growth through its effect on cell expansion of performed shoot primordial and development of new primordial. Also water stress depresses RNA level and consequently retards growth. Such results might be due to that water stress reduces the development of lateral buds, which affect number of branches.

Table 5: Effect of interaction between fertilizers types and irrigation rates treatments on dry yield of inflorescences/fed., volatile oil percentages and yield/fed. as well as nitrogen percentage of chamomile plants during 2003/2004 and 2004/2005 seasons

Treatments	Irrigation rates (m^3/fed.)					
	467	933	1400	467	933	1400
Fertilizers types	First season			Second season		
	Dry yield of inflorescence (kg/fed.)					
NPK	80.0 hi	362.1 e	428.9 d	110.6 m	540.4 h	673.4 e
COC	66.7 i	266.2 g	326.0 f	88.2 m	470.4 i	579.4 g
FYM	93.3 hi	369.6 e	420.0 d	145.6 l	617.9 f	805.2 c
NPK+COC	106.9 h	375.4 e	526.0 b	192.3 k	689.5 e	835.1 c
NPK+FYM	122.0 h	462.9 c 462.5 c	741.5 a 732.7 a	253.2 j 235.0 j	760.2 d 734.3 d	1186.7 a
NPK+COC+FYM	1 14.3 h					1148.7 b
	Volatile oil (%)					
NPK	0.50 c	0.43 d	0.40 d	0.55 c	0.47 d	0.46 d
COC	0.49 c	0.40 d 0.56 b	0.38 ed	0.51 cd	0.46 d	0.44 d
FYM	0.57 b	0.36 de	0.50 c	0.60 b	0.58 bc	0.53 c
NPK+COC	0.38 de	0.60 ab	0.34 e	0.45 d	0.42 de	0.40 e
NPK+FYM	0.64 a	0.52 bc	0.58 b	0.68 a	0.67 a	0.62 b
NPK+COC+FYM	0.56 b		0.54 bc	0.60 b	0.57 bc	0.58 bc
	Volatile oil yield (L/fed.)					
NPK	0.40 o	1.56 h	1.72 g	0.61n	2.54 i	3.10 g
COC	0.33 p	1.07 k	1.24 j	0.45 n	2.16 j	2.55 i
FYM	0.53 n	2.07 e	2.10 e	0.87 m	3.58 e	4.27 d
NPK+COC	0.41 o	1.35 i	1.79 f	0.86 m	2.90 h	3.34 f
NPK+FYM	0.78 l 0.64	2.78 c	4.30 a	1.72 k	5.09 c	7.36 a
NPK+COC+FYM	m	2.41d	3.96 b	1.41 l	4.19 d	6.66 b
	Nitrogen (%)					
NPK	3.89 f	4.15 c	3.91f	3.70 h	4.19 f	3.87 g
COC	4.83 c	5.17 a	4.97 b	4.89 c	5.40 a	5.12 b
FYM	3.55 h	3.60 h	3 58 h	3.15 jk	3.21 j	3.18 jk
NPK+COC	4.22 e	4.65 d	4.60 d	4.50 e	4.73 d	4.65 d
NPK+FYM	3.16 j 3.65	3.40 i	3.25 j	2.84 l	2.92 l 3.64 h	3.10 k 3.50 e
NPK+COC+FYM	gh	3.82 fg	3.74 g	3.45 i		

NPK= chemical fertilization, COC= compost olive cake and FYM= farmyard manure. Values heaving the same alphabetical letters did not significantly differ at 0.05 level of significance according to Duncan's multiple range test

The increase in fresh and dry weights of herb/plant and yearly yield of inflorescences/plant as well as per fed. of chamomile plants by increasing irrigation quantity resulted in lower stomata resistance, and hence higher conductance and photosynthetic activity. On the other hand, unfavorable effect of drought on fresh and dry matter production might be to the reduction in uptake of nutritional elements that cause a disturbance in the physiological processes needed for plant growth (Slatyer, 1969) and /or to the reduction in leaf area and photosynthetic rate (Fisher and Hogan, 1965) and /or to that low water level also caused reduction in CO_2 assimilation due to stomata close (Hsiao and Acevedo, 1974) and /or to that the photosynthetic efficiency began to decrease with a slight deficit in the soil moisture content due to the decrease in the mesophyll photosynthetic activity at high xylem water potential (Gawish, 1992). This in turn might explain the reduction in fresh and dry weights of chamomile herb with decreasing irrigation water quantity.

Application of high level of water resulted in an increase in phosphorus, potassium and total carbohydrate percentages in herb of chamomile plant, which might be attributed to stimulatory effect of water on absorbing efficiency of plants through out their great solubility, as suggested by Shimshi, (1969) who revealed that high moisture stress reduced the availability of minerals. In addition, the increase in nitrogen, phosphorus, potassium and total carbohydrate percentages might be attributed to the increase in leaves dry matter accumulation with increasing water levels.

Since the water content can ever be a directly limiting factor in photosynthesis (Fogg, 1972) therefore, the accumulative carbohydrates with increase of irrigation levels.

As for the fertilization effect (Table 2), it is clear that using NPK plus FYM at 30 m^3/fed. was the effective treatment to produce 442.1 and 733.3 kg/fed. of the dry inflorescences and 2.62 and 4.72 l/fed. of volatile oil during the first and second seasons,

Table 6: Effect of interaction between fertilization types and irrigation rates treatments on phosphorus, potassium and total carbohydrate percentages as well as water use efficiency of chamomile plants during 2003/2004 and 2004/2005 seasons

Treatments	Irrigation rates (m^3/fed.)					
Fertilizers types	467	933	1400	467	933	1400
	First season			Second season		
			Phosphorus (%)			
NPK	0.37 a	0.40 a	0.43 a	0.40 a	0.42 a	0.48 a
COC	0.18 a	0.22 a	0.28 a	15 a	0.20 a	0.25 a
FYM	0.56 a	0.60 a	0.64 a	a	0.56 a	0.58 a
NPK+COC	0.28 a	0.30 a	0.30 a	a	0.28 a	0.30 a
NPK+FYM	0.46 a	0.51 a	0.52 a	0.48 a	0.50 a	0.54 a
NPK+COC+FYM	0.32 a	0.34 a	0.36 a	0.30 a	0.32 a	0.38 a
			Potassium (%)			
NPK	2.50 a	2.54 a	2.63 a	2.32 a	2.38 a	2.42 a
COC	1.62 a	1.96 a	2.10 a	1.48 a	1.82 a	2.04 a
FYM	3.00 a	3.05 a	3.12 a	2.80 a	2.82 a	2.86 a
NPK+COC	2.16 a	2.19 a	2.28 a	2.19 a	2.21 a	2.25 a
NPK+FYM	2.78 a	2.80 a	2.84 a	2.45 a	2.63 a	2.72 a
NPK+COC+FYM	2.30 a	2.38 a	2.42 a	2.26 a	2.30 a	2.30 a
			Total carbohydrate (%)			
NPK	10.46 a	11.73 a	13.05 a	9.87 a	10.85 a	13.73 a
COC	11.53 a	12.23 a	14.11 a	10.45 a	12.70 a	14.87 a
FYM	10.74 a	12.10 a	13.90 a	10.15 a	11.32 a	14.11 a
NPK+COC	11.65 a	12.70 a	14.23 a	10.50 a	12.88 a	15.40 a
NPK+FYM	10.30 a	11.72 a	12.74 a	9.33 a	10.62 a	13.05 a
NPK+COC+FYM	10.60 a	12.07 a	13.62 a	9.54 a	11.13 a	13.91 a
			Water use efficiency (kg/m^3)			
NPK	0.137 de	0.345 bc	0.283 bc	0.079 ef	0.290 cd	0.289 cd
COC	0.115 e	0.254 cd	0.215 cd	0.063 f	0.252 d	0.248 d
FYM	0.160 de	0.353 b	0.277 c	0.104 ef	0.331 c	0.345 bc
NPK+COC	0.184 de	0.358 b	0.347 bc	0.137 e	0.370 bc	0.358 bc
NPK+FYM	0.209 cd	0.441 a	0.489 a	0.181 de	0.408 b	0.509 a
NPK+COC+FYM	0.196 d	0.441 a	0.483 a	0.168 e	0.394 bc	0.492 a

NPK= chemical fertilization, COC= compost olive cake and FYM= farmyard manure. Values heaving the same alphabetical letters did not significantly differ at 0.05 level of significance according to Duncan's multiple range test.

respectively. On the other side, using composted olive cake alone at 30m^3/fed. produced the least yield 219.6 and 379.3 kg/fed. of dry inflorescences. Using combination of NPK plus COC resulted in 336.1 and 572.3 kg/fed. of dry inflorescences and less volatile oil yield 1.18 and 2.37 l/fed. and using FYM resulted in 294.3 and 522.9 kg/fed. dry inflorescences and 1.57 and 2.91 l/fed. volatile oil yield. So, it is clear that using NPK (300, 300 and 100 kg/fed.), COC (30 m^3/fed.) or FYM (30 m^3/fed.) each alone was not enough to obtain economic yield in such sandy soil. In this regard, it was found by Kamel-Dawh *et al.* (2002) that rising organic manure (poultry manure) from 10m^3/fed. to 40m^3 / fed. plus NPK fertilizers at 300, 300 and 100 kg/fed. resulted in economic yield of dry inflorescences.

Concerning using COC, it was found previously (Marzouk, 2002) that olive cake in addition to sewage sludge and tomato residues increased the yield of barley plant and increased the availability of nitrogen and phosphorus in sandy and calcareous soils. Also, when pressed olive cake was used in combination with chicken manure in sandy soil, the best vegetative growth and fruit yield of tomato was obtained (El-Kassas and Abd-El-Mowly, 1999). In the herein work the used amount of COC, if used alone, may be need to increase over 30m^3/fed. to be used without NPK fertilization.

Data in Table (3) concerning chemical analysis, nitrogen, phosphorus, potassium and total carbohydrate percentages indicate that although COC fertilization showed the highest total nitrogen and total carbohydrate percentages in plant herb of chamomile, it decreased both phosphorus and potassium percentages. So, it appears to be not efficacious in giving the adequate balance of these constituents to enhance growth and flowering. Adding NPK plus COC might improve this balance to some extent and reflected positively on

growth and flowering. On the other side, NPK plus FYM might exhibit the favor balance between these constituents, so reflected in good vegetative growth and flowering.

In the herein work, the increments of fresh and dry weights of herb/plant and yearly yield of inflorescences/plant and per fed. as a result of application NPK plus FYM may be due to the high contents of N and its affect on soil properties which improved the soil fertility through increasing the soil acidity due to formation of CO_2 and other organic acids (El-Shafie and El-Shikha, 2003). Moreover, application of organic manure improve the physio-chemical and biological properties which increase the dry matter in soils which may could increase the action of exchange capacity, encourage the rhizosphere bacteria, which enhance plant growth by production of phytohormones as IAA, CYT and GA as reported by Frankenberger and Arshad (1995). Application of COC separately inhibited plant growth, this result was agreeable with those reported by Tesi *et al.* (1987) who reported that application of composted olive pressed cake gave poor plant growth of *Tagetes patula* nana owing to phytotoxicity rather than lacked of nutrition.

Concerning, water use efficiency by chamomile plants, water economy was increased with increasing the amount of irrigation water. These results are in harmony with those reported by Ali (2001) on *Hyoscyamus muticus* L. plant in North Sinai. In this concern, Todd (1972) reported that water stress inhibited nitrate reductive activity. Marschner (1995) said that water stress depress nitrogenous activity, while Streeter (1993) reported that a decrease in phloem solute import presumably inhibits N export and N_2 fixation water limitation for xylem export. It could be concluded from these reports that water deficit decrease nitrogen's and nitrate reductive and N_2 fixation which in turn may affect in vegetative growth, dry matter, carbohydrates which produce the inflorescences.

REFERENCES

Abd-El-Moneim, A.M. 1999. Response of some promising bread wheat genotypes to some supplementary irrigation treat-ment with rainfall in North Sinai. Egypt. J. Appl. Sci. 14 (5):139-154.

Abe, H. and T. Nakai 1999. The effect of the water statues within a tree on tracheid morphogenesis in Cryptomeria japonica. D. Don. Trees; Structure and Function 14(3): 124-129. (CAB on line Abstr. J. 2000, 060-0376).

Agena, E.A. 1975. Effect of some environmental and soil factors on growth and oil production of chamomile (Matricaria chamomilla L.) Ph.D. Thesis, Fac. Agric., Ain Shams Univ., Cairo, Egypt.

Ali, M.A.M. 2001. Effect of irrigation water quantity on Hyoscyamus muticus L. plant characters under North Sinai conditions. Zagazig J. Agric. Res., Vol. 28 No. (1):41-58.Egypt.

A.O.A.C. 1980. Official Methods of Analysis. 12th ed. Association of Official Analytical Chemists. Washington. D. C., USA.

British Pharmacopoeia. 1963. Determination of volatile oil in drugs. Published by the pharmacentical press, London.

Brown, J. and O. Lilliland 1946. Rapid determination of potassium and sodium in plant material and soil extracts by flam photometry. Proc. Amer. Soc. Hort. Sci. 48: 341-346.

Dubois, M., R. A. Gilles, J. Hamilton, R. Rebers, and I. Smith 1956. Colorimetric method for determination of sugars and related substances. Anal.Chem. 28: 350-356.

Duncan, B.D. 1958. Multiple ranges and multiple F-tests. Biometrics 11: 1- 42.

El-Kassas, A.I. and S.E. Abd-El-Mowly 1999. Effect of some organic manure on growth and productivity of tomato plants grown in plastic greenhouses under North Sinai conditions. J. Agric. Sci., Mansoura Univ., 24(12): 7645-7653.Egypt.

El-Shafie, F.S.S. and S.A. El-Shikha 2003. Productivity and nutrients uptake of wheat and faba bean growth on calcareous soil as affected by organic manure and saline irrigation water. Menofiya Univ. J. Agric. Res. 28(3):1025-1048. Egypt.

Emongor, V.E. and J.A. Chweya 1992. Effect of nitrogen and variety on essential oil yield and composition from chamomile flowers. Tropical Agriculture 69(3): 290-292, Kenya (C.F. Hort. Abstr. 1993 Vol. 63 (6): 4522).

Essa, A.M. 1999. Effect of some cultural treatments on growth and yield of Matricaria chamomilla L. plant. Ph. D. Thesis, Fac. Agric., Ain Shams Univ, Egypt.

Fisher, R.A. and R.M. Hogan 1965. Plant water relations, irrigation management and crop yield. Exp. Agric. 1:161-177.

Fogg, G.E. 1972. Photosynthesis (Second Edition). The English Language Book Soc, and the English Universities Press LTD, London.

Frankenberger, W.T. and M. Arshad 1995. Phytohormons in Soil Microbial and Function. Marcel Dekker Inc. New York Basel, Hong Kong p.503.

Gawish, Ragaa A. 1992. Effect of antitranspirants application of snap beans (Phaseolus vulgaris L.) grown under different irrigation regimes. 1. Growth, transpiration rate and leaf content of water, NPK and total carbohydrates. Menofiya Univ. J. Agric. Res. 17:1282-1308. Egypt.

Gindich, N.N. and V.V. Sheberstov 1969. Effect of organic fertilizers on the yield of chamomile and removal of nutrients. Trudy Vsesoy Nauchno Issledovatel, Inst. Lekarstv. Rastenii No. 150-5 [Russian, from Ref. Z (Rasten), Astr. 6-55-807] (C. F. Hort. Abstr. 1970 Vol. 40 (1): 1907).

Hsiao, T.C. and E. Acevedo 1974. Plant response to water deficits, water use efficiency and drought resistance. Agric. Meteorology 14: 59-84.

Hucker, T. and G. Catroux 1980. Phosphorus in sewage ridge and animals waster slurries. Proc. of the EEC Seminar, Haren (Gr): Groningen Nether Lands 12, 13 June.

Johri, A.K., L.J. Srivastava, J.M. Singh, and R.C. Rana 1992. Effect of planting time and level of nitrogen on flower and oil yield of German chamomile (Matricaria recutita) Indian J. of Agronomy 37 (2): 303-304, India. (C.F. Hort. Abstr. 1994 Vol. 64 (1): 674).

Jolivet, Z. 1977. Importance of mineral nutrition in the production of capitula and essential oil of Anthemis nobilils. Plantes Medicinales et Phytotherapie 11 (2): 119-123, France. (C. F. Hort. Abstr. 1978 Vol. 48 (1): 763).

Kamel-Dawh, A., A.E. Awad, S.M. Mohamed, and R.M. Yousef 2002. Response of Matricaria chamomilla L plant to drip irrigation and fertilization in sandy soil. I- Vegetative growth and flowering. 2nd Inter. Conf. Hort. Sci., 10-12 Sept. 2002, Kafr El-Sheikh, Tanta Univ., Egypt.

Kandeel, A.M.A. 1982. Effect of some agricultural treatments on the yield and oil percentage of chamomile plant (Matricaria chamomilla L.) M.Sc. Thesis, Fac. Agric., Ain Shams Univ., Cairo, Egypt.

Kozlowski, T.T. 1971. Growth and Development of Tress, Vol. (1), Academic Press, New York.

Marschner, H. 1995. Mineral Nutrition of Higher Plants 2nd. (ed.) Academic Harcourt Brace and Company Publisher, New York, London, Tokyo 889.

Marzouk, E. R. E. 2002. Effect of organic residues on phosphorus availability in some soils of North Sinai. M. Sc., Thesis, Fac. Environ. Agric. Sci. El-Arish, Suez Canal Univ., Egypt.

Mohamed, S. M. 1988. Effect of chemical fertilization on growth, yield and essential oil content in some strains of chamomile plants. M.Sc. Thesis, Fac. Agric., Cairo Univ., Cairo, Egypt.

Nour, E.M.E. 1999. Effect of some agricultural treatments on pea under sandy soil conditions. M. Sc. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Page, A.L. 1982. Methods of Soil Analysis. Part 2: Chemical and Microbiological Properties. Second edition No.9 (part) in the series Agronomy, Wisconsin, USA.

Saleh, M.M. (1962): The effect of fertilizer level on the quantity and quality of Matricaria chamomilla L. oil. M. Sc. Thesis, Fac. Agric., Ain Shams Univ., Egypt.

Shimshi, D. 1969. The effect of nitrogen supply on transpiration, stomata behavior and some indices of plant relations of beans (Phaseolus vulgaris L.). New Phytol 69: 405-424.

Slatyer, R.O. 1969. Physiological significance of internal water relations to crop yield. In Easton, J.D., F.A. Hoskins, and C.H. Von Bevel (Eds): Physiological Aspects of Crop Yield. Pp.53-88, Soc. Agron and Crop Sci. Madison, Wisconsin.

Snedecor, G.W. and W.G. Cochran 1980. Statistical methods, 7th ed. Iowa State College Press, Ames., Iowa, USA.

Streeter, J.G. 1993. Translocation, A key factor limiting the efficiency of nitrogen fixation in legume nodules. Physiology Plant, 87: 616-623.

Tesi, R., D. Tosi, A. Marchi, and R. Tallarico. 1987. The growth of Tagetes patula nana in substrates based on olive pressed cake and grape pomace. Colture-Protette. 16(3):94-96.

Todd, G.W. 1972. Water deficits and enzymatic activity. In Kozlowski, p. 117-216.

Utilizing the concept of Nutrients as a Currency Top, G.F., C.A. Watson, and E. Stockdale. 2002. within Organic Farming System. In: Powell et al. (Eds.) Proc. of the COR Conf. 26-28 March, UK, p. 157-160

تأثير بعض أنواع الأسمدة و مستويات الري بالتنقيط على إنتاجي نباتات البابونج تحت ظروف منطقة العريش

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أجرى هذا العمل بهدف دراسة التأثير المشترك لمعاملات التسميد (التسميد الكيماوي، وتفل زيتون مكمور، و سماد الماشية، ومخاليط من هذه الأسمدة)، وكميات مياة الري (٤٦٧ و٩٣٣ و١٤٠٠ متر مكعب/فدان) على نمو ومحصول كلا من النورات الزهرية و الزيت الطيار، وبعض المكونات الكيميائية لنباتات البابونج خلال ا لموسم الأول ٢٠٠٣/٢٠٠٤(قليل الأمطار) والموسم الثاني ٢٠٠٤/٢٠٠٥ (كثيرة الأمطار).

أوضحت النتائج المتحصل عليها أنة تحت ظروف شمال سيناء (منطقة العريش) أن زيادة مستويات الري بالتنقيط من ٤٦٧ إلى ١٤٠٠ متر مكعب /فدان خلال الموسم الثاني الذي كان مطيرا متحدا بالتسميد الكيماوي (٣٠٠ و٣٠٠ و١٠٠ كجم/فدان من كل من سلفات الامونيوم، وسوبر فوسفات الكالسيوم، وسلفات البوتاسيوم على التوالي) بالإضافة إلى سماد الماشية أحدث زيادة مقدارها ٦٠% في محصول الفدان من النورات الزهرية الجافة، و ٧١,٢% في محصول الزيت الطيار، حيث كانت أفضل من تأثير نفس المعاملات خلال الموسم الأول الذي كان قليل الأمطار. كما أدى زيادة مستوى الري (١٤٠٠ متر مكعب/فدان) خلال الموسم الأول إلى الحصول على محصول اقتصادي من النورات الزهرية والزيت الطيار، كما أظهرت النتائج أن زيادة مستويات الري مع التسميد الكيماوي متحدا مع سماد الماشية العضوي (٣٠ مترا مكعبا/فدان) صفه الاتزان في محتوى العشب من كل من النتروجين، و الفسفور، والبوتاسيوم، والكربوهيدرات الكلية.

كانت كفاءة استخدام المياه عند أعلا قيمة معنوية لها خلال الموسم الثاني مع مستوى الري المرتفع(١٤٠٠ مترا مكعبا/فدان) باستخدام معاملات التسميد الكيماوي متحدا مع سماد الماشية.