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WATER REQUIREMENTS OF CROPS UNDER NORTH SINAI CONDITIONS: 1- IRRIGATION TIMING AND ORGANIC FERTILIZER STUDIES CONDUCTED FOR THE IMPROVED WATER USE EFFICIENCY FOR SOME AROMATIC AND MEDICINAL PLANTS

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This work is an attempt to clarify the effect of organic manures and water management in sandy soils to improve water use parameters of some aromatic and medicinal plants under daily drip irrigation, with emitters adjusted to 4 l/hour under desert conditions at the El-Sheikh Zuwayid region, North Sinai, Egypt. The study was conducted in split-plot design as four replicates. The treatments include three daily irrigation times (¼ hour = 1 liter/plant; ½ hour = 2 liter/plant; ¾ hour = 3 liter/plant) and the use of three types of organic manures (peat moss, compost and chicken manure) at about 20 m^3/feddan. The results were analyzed statistically revealing a highly significant increase in aromatic and medicinal plant yields, and water use efficiency together with the investment ratio of the irrigated daily ½ hour fertilizered by chicken manure. Similarly, an increase in water economy by decreasing irrigation time and use of chicken manure was also determined. Moreover, a highly significant decrease in water consumptive use and the crop coefficient, by decreasing the irrigation time and fertilizers with compost manure was obtained. Depending on the detection of the water consumption for all treatments and economical assessment, the rate of 2 liter/day (½ hr/day) yielded the highest profitable gains. The rate of 1 liter/day (¼ hr/day) seems to cause the accumulation of salts in the root zone, while the 3 liter/day (¾ hr/day) treatment induced the leaching of the fertilizers from the rhizosphere, both reducing crop growth. The highest productivity was obtained by the use of chicken manure together with 2 liter/day (½ hr/day) treatment. The empirical averages of the Kc obtained from the experiment, for the plants, were 0.64, 0.59 and 0.58 for the Egyptian Henbane, Echium and Achillea, respectively.

Keywords: water requirements, irrigation time, organic manure, *Egyptian Henbane, Echium, Achillea*, water use efficiency.

The global problem of water resource shortage, is a critical issue demanding the development of sustainable water management programs for the arid and semi-arid regions like Egypt. The use of modern irrigation systems, like the drip, needs proper soil nutrition either by chemical or organic fertilizers. Improper timing and scheduling of irrigation water may cause, leaching or accumulation of the chemicals in the irrigated zone with hazardeous effects on plant roots and yields. Furthermore, the desert soils of the region are characterized by low organic matter contents which need the improvement by the addition of organic manures as stated by Haynes and Naidu (1998); Johnson and Hoyt (1999); Awadalla *et al.* (2002) and Viale Delle Terme Di Caracalla (2003), who also determined that the use of only 1.5 % of a composted organic source for one season improved almost all soil properties as well as the yield and water use efficiency.

Shaxson and Barber (2003) and Kirda (2000) stated that, reductions in yields from disease and pests, losses during harvest and storage, and arising from insufficient applications of fertilizers are much greater than reductions in yields expected from deficit irrigation. On the other hand, deficit irrigation and the insufficient use of fertilizers necessitate the adoption of flexible planting dates, and selection of shorter-season varieties to increase crop quality. Moutonnet (2000) stated that, the upper limit for yield is set by soil fertility, climatic conditions and management practices as is in the case of evapotranspiration. Any significant decrease in soil water storage has an impact on water availability for a crop and, subsequently, on actual yield and actual evapotranspiration.

EL-Sersawy and Awadalla (1993) mixed 2 % rice straw or farmyard manure and town refuse with 10 kg soil in pots. They found a positive result to total soil heat content, which is generally affected by soil heat capacity. Ismail (1999) and Ahmed (1999) found that different application of organic manures increased soil heat capacity values, as well as the field capacities and wilting points for sandy and sandy clay loam (calcareous) soils. Also, Mikhail (1997) and Fanous and Mikhail (1997) found that organic matter additions generally increase the moisture content in general.

Unger *et al.* (1988) found that practices to improve rainfall use efficiency include those that; 1- increase water infiltration and reduce runoff by residue management, 2- increase soil water – storage capacity by adding organic matter, 3- reduce evaporation by mulches, 4- reduce deep percolation of water by growing deep – rooted crops, 5- reduce evapotranspiration by controlling weeds and volunteer crop plants, and increase yields relative to the amount of water transpired by timely crop establishment, and 6- controlling insects and diseases, providing adequate nutrients, and timely crop harvest.

Medicinal and aromatic, common perennial plants prefer hot, semi-dry conditions and languish in wet conditions, and daily watering. Standberry and Bernstein (2000), Biondi and Fornale (2000) and Mateus and Cherkaoui (2000) concluded that some medicinal plants like the Egyptian henbane and *Hyoscyamus muticus* may be pest producing or on the contrary poisonous.

Lapinskas (2000) and Amirghofran *et al.* (2000) reported that, Echium (*Vipers bugloss*) was an important medicine for snake venom and a diuretic as well as demulcent whereas the traditional medicine made use of leaves of *Echium amoenum* as a diuretic, demulcent, emollient and expectorant. The leaves, especially those growing near the root, make a good cordial on infusion, which operates by perspiration and alleviates fevers, headaches and nervous complaints, relieving inflammatory pains. The infusion is made from the dried leaves to a pint of boiling water, and is given in wineglassful to teacupful doses, as requiring little to moderate water.

Chevallier (1996), Grigson (1996) and Newall *et al.* (1996) stated that *Achillea* (*Yarrow*) *millefolium* is a common perennial plant, which has been used for centuries in medicine and possesses slightly astringent properties as a tonic, being alterative and diuretic used in chronic diseases of the urinary system. It exerts a tonic influence upon the veins, as well as upon mucous membranes. It has been efficient in sore throat, hemoptysis, hematuria and other forms of hemorrhage where the bleeding is small in amount, incontinence of urine, diabetes, hemorrhoids with bloody or mucoid discharges, and dysentery; also in amenorrhoea, flatulency and spasmodic diseases, and in the form of injection in leucorrhoea with relaxed vaginal walls.

Several other investigators have also recently concluded that water use efficiency and water economy increased with the decreasing amount of irrigation water, increasing irrigation intervals and by adding organic matter (Allen *et al.*, 1998; Rizk, 2002; Seidhom *et al.*, 2002 and El-Dosouky *et al.*, 2005).

This work is an attempt to clarify the effect of adding types of organic manures and water management in sandy soils to improve water use parameters of some aromatic and medicinal plants.

MATERIALS AND METHODS

The current work was carried out in the Agricultural Experimental Station of the Desert Research Center at EL-Sheikh Zuwayid City, about 35 km east of El-Arish city, north Sinai Governorate during 2003/2004 season.

This work is an attempt to clarify the effect of adding types of organic manure and water management in sandy soils to improve water use efficiency and water economy of some aromatic and medicinal plants under daily drip irrigation with 4 liter /hour.

A meteorological station is located inside the experimental field whose altitude is about 15 meters above sea level. Its location is 31°.08` N and 34°.01` E. The meteorological data for the two seasons were used to compute potential evapotranspiration (ETo) rates using the Penman – Monteith equation (Table 1) as recommended by CROPWAT, software version 5.7 (Smith, 1992) to calculate crop coefficient (Kc). While proposed irrigation water amounts based on ETo values for the average of 8 years (Table 1) as 2, 4 and 6 liter/m^2.

TABLE (1). Meteorological data of El-Sheikh Zuwayid region, north Sinai during 2003/2004 and ETo average of 8 years (1996 - 2003).

Season 2003	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Avg.
Max. temp. (°C)	21.20	19.74	21.35	27.75	32.76	35.64	38.61	39.63	37.59	33.99	28.35	21.74	29.86
Min. temp. (°C)	7.07	6.58	7.12	9.25	10.92	11.88	12.87	13.21	12.53	11.33	9.45	7.25	9.95
Avg. temp. (°C)	14.13	13.16	14.23	18.50	21.84	23.76	25.74	26.42	25.06	22.66	18.90	14.49	19.91
Max. relative humidity (%)	82.43	73.51	81.41	78.07	87.59	92.28	91.33	92.42	83.75	89.80	87.31	81.64	85.13
Min. relative humidity (%)	47.09	43.70	46.31	37.26	36.49	35.59	32.56	32.08	30.67	36.19	40.99	45.95	38.74
Wind speed (km/day)	259.20	245.52	164.40	177.60	141.36	76.08	176.40	76.32	163.92	297.84	201.60	274.56	187.90
Actual sunshine hours (n)	6.80	7.60	8.20	9.30	10.20	11.60	11.70	11.40	10.30	9.30	7.70	6.60	9.23
Rain (mm/month)	37.08	15.48	41.15	13.21	0.00	0.00	0.00	0.00	1.02	0.25	2.29	23.62	*134.10
ETo (mm/day)	2.35	2.85	3.06	4.51	5.29	5.62	6.79	5.73	5.69	5.10	3.09	2.48	4.38
Season 2004	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Avg.
Max. temp. (°C)	19.65	20.06	24.89	26.99	30.95	34.82	38.66	39.09	37.53	34.70	28.40	19.79	29.62
Min. temp. (°C)	6.55	6.69	8.30	9.00	10.32	11.61	12.89	13.03	12.51	11.57	9.47	6.60	9.87
Avg. temp. (°C)	13.10	13.37	16.59	17.99	20.63	23.21	25.77	26.06	25.02	23.13	18.93	13.19	19.75
Max. relative humidity (%)	79.55	88.63	81.52	85.23	85.55	92.99	94.61	91.99	88.51	95.23	90.16	88.49	88.54
Min. relative humidity (%)	47.41	52.24	42.08	41.54	37.43	36.66	33.69	32.38	32.47	37.67	42.28	52.55	40.70
Wind speed (km/day)	237.60	281.52	235.44	205.68	169.68	79.68	105.36	114.96	59.04	234.72	310.08	125.52	179.94
Actual sunshine hours (n)	7.06	7.74	8.28	9.38	10.41	11.90	11.96	11.25	10.30	9.08	7.69	6.71	9.31
Rain (mm/month)	33.02	29.21	19.05	0.25	0.50	0.00	0.00	0.00	0.00	0.76	75.94	99.31	*258.04
ETo (mm/day)	2.21	2.46	3.69	4.44	5.28	5.59	6.21	6.02	4.59	4.63	3.52	1.69	4.19
ETo (mm/d) of 8 years	2.15	2.65	3.19	4.43	5.18	5.70	6.11	5.77	5.20	4.12	3.12	2.39	4.17

ETo = potential evapotranspiration * = total

In general, the north eastern part of the Sinai peninsula is characterized by the Mediterranean climate, with hot and dry summers and relatively cold winters.

The physical and chemical characteristics of the soils of the studied site are illustrated in tables (2 a and b). The relevant physical and chemical properties of the soil of the experimental site were determined according to Richards (1954). The soils are non-saline non-alkali while soil texture is sandy with 7 % w/w available moisture.

TABLE (2a). Some soil physical properties.

Soil depth (cm)	Particle size distribution (%)				Texture class	Particle density (g/cm^3)	Bulk density (g/cm^3)	Porosity (%)	Organic matter (%)	Moisture content (%)		Available soil water/layer		Infiltration rate	
	Coarse sand	Fine sand	Silt	Clay						Field capacity	Wilting point	%	mm	cm/hr	Class
0-30	7.57	87.55	2.47	2.41	Sandy	2.52	1.46	42.11	0.26	9.89	2.79	7.10	103.7	16.4	Very rapid
30-60	7.25	87.81	2.69	2.25	Sandy	2.55	1.45	43.32	0.24	10.12	2.87	7.25	104.8		
60-90	8.02	86.28	2.55	3.14	Sandy	2.54	1.43	43.89	0.29	8.44	2.59	5.85	83.4		
90-120	7.75	86.61	2.29	3.34	Sandy	2.60	1.50	42.31	0.27	8.46	2.64	5.82	87.3		

TABLE (2b). Some soil chemical and physico-chemical properties.

Soil depth (cm)	$CaCo_3$ (%)	pH soil paste	E.C (dSm^{-1})	Soluble cations (me/l)				Soluble anions (me/l)				CEC (me/100 g soil)	Exchangeable cations (me/100g soil)			
				Ca^{++}	Mg^{++}	Na^+	K^+	$CO_3^=$	HCO_3^-	$SO_4^=$	Cl^-		Ca^{++}	Mg^{++}	Na^+	K^+
0-30	4.87	7.88	1.63	8.02	1.19	1.50	5.58	_	4.19	7.53	4.59	4.62	3.28	0.30	0.83	0.21
30-60	4.94	7.91	1.69	8.27	1.32	1.57	5.71	_	4.46	7.48	4.88	4.67	3.44	0.35	0.64	0.24
60-90	5.33	7.85	1.72	8.31	1.39	1.64	5.85	_	4.86	6.09	6.23	4.71	3.48	0.36	0.67	0.20
90-120	5.41	7.97	1.73	8.47	1.50	1.57	5.80	_	4.64	6.18	6.52	4.79	3.54	0.34	0.73	0.18

The experimental design was split-plot with four replicates for each treatment. Three different irrigation times (¼ hour = 1 liter/plant), (½ hour = 2 liter/plant) and (¾ hour = 3 liter/plant) were used and three types of organic manure (peat moss, compost and chicken manure), 20 m^3/feddan were applied to the soils before planting.

Seeds of some aromatic and medicinal plants (*Egyptian Henbane, Echium and Achillea*) were sown at a rate of 250 g/feddan on September, 5^{th} 2003, October 15^{th}, 2003 and October 7^{th}, 2003, respectively. Seedlings were translocated from nursery house, and planted in rows on December 15^{th} 2003, December 20^{th}, 2003 and December 23^{th}, 2003, respectively. Drip irrigation system having 4 liter / hour GR dripper was used. The distance between the lateral lines was one meter and drippers were located at ½ meter apart. Consequently, the number of plants per feddan was 8000. Ground water was used for irrigation. It is salinity was 3100 ppm, table (3). The chemical properties of the organic manures applied to the soil are shown in table (4).

TABLE (3). Che.aical analysis of the irrigation water of the north Sinai research st:tion.

Season	pH	E.C.		S.A.R	R.S.C (me/l)	T.D.S (ppm)	Units	Soluble cations				Total	Soluble anions				Total	Class
		ppm	dSm^{-1}					Ca^{++}	Mg^{++}	Na^{+}	K^{+}		CO_3^{-}	HCO_3^{-}	$SO_4^{=}$	Cl^{-}		
Winter	7.8	3099	4.84	16.55	-4.82	[illegible]	ppm.	88.88	76.08	880.0	12.0	1057.0	0.00	358.2	625	1059	1863	C_5S_4
							epm.	4.44	6.26	38.26	0.31	49.26	0.00	5.87	13.01	29.86	48.74	
							%	9.00	12.71	77.67	0.62	100.0	0.00	12.05	26.70	61.26	100.0	
Summer	7.6	3236	5.06	9.45	-18.92	3161	ppm.	215.7	128.64	710.0	8.00	1062.3	0.00	148.23	725	1300	2099	C_5S_3
							epm.	10.76	10.58	30.87	0.20	52.42	0.00	2.43	15.09	36.66	54.19	
							%	20.53	20.19	58.89	0.39	100.0	0.00	4.48	27.86	67.66	100.0	

S.A.R = Sodium adsorption ratio, R.S.C. = Residual sodium carbon, T.D.S = Total dissolved solids, epm = equivalent per million.

TABLE (4). Some chemical properties of the organic manures applied to the soil.

Organic manure types	pH	E.C. (dS/m)	OM (%)	C (%)	N (%)	P (%)	K (%)	C/N
Peat moss	7.72	1.84	52.28	29.33	2.21	0.48	0.81	13.27
Compost	7.83	1.86	55.12	32.15	2.24	0.62	1.06	14.35
Chicken manure	7.94	1.88	54.44	33.15	2.27	1.65	1.98	14.60

OM = Organic matter, C = Carbon, N = Nitrogen.

All plants received the recommended doses of mineral fertilization NPK: 70, 30 and 70 units, respectively by fertigation. All plants were harvested on June 7th 2004, June 15th 2004 and June 27th 2004, respectively. Their growing periods in the nursery were 101, 66 and 77 days, whereas in the field they were 175, 178 and 187 days, respectively, but their irrigation period were 160, 160 and 170 days, respectively.

The amounts of applied irrigation water are shown in table (5) included rainfall all over the season. The amounts of applied nursery irrigation are calculated as = ((8 liter/m^2) x (nursery area/8000 plant about 80 m^2) x (reduction factor 0.25) x (nursery irrigation period)) / 1000 = m^3/feddan. All plants were irrigated in nursery by 16.16, 10.56 and 12.32 m^3/feddan, respectively.

TABLE (5). Irrigation water applied plus rainfall for some aromatic and medicinal plants grown at El-Sheikh Zuwayid region.

Treatments	m^3/feddan /day	*Egyptian Henbane*		*Echium*		*Achillea millefolium*	
Daily irrigation		m^3/feddan /season	mm/feddan /season	m^3/feddan /season	mm/feddan /season	m^3/feddan /season	mm/feddan /season
¼ hour (1 liter/plant)	8	1691.89	402.83	1670.29	397.69	1742.45	414.87
½ hour (2 liter/plant)	16	2971.89	707.59	2950.29	702.45	3102.45	738.68
¾ hour (3 liter/plant)	24	4251.89	1012.35	4230.29	1007.21	4462.45	1062.49

To determine the actual water consumption, soil moisture tension was measured by tensiometer, while moisture content was determined by gravimetric method and hence the actual evapotranspiration was calculated by the following equation:

$ETa = (M._2 \% - M._1 \%) \times d_b \times D \times 1000$ (Doorenbos and Pruitt, 1977)

Where :

ETa = Actual evapotranspiration, mm.

$M._2$ = Moisture content after irrigation, %.

$M._1$ = Moisture content before irrigation, %.

d_b = Bulk density of soil, g/cm^3.

D = Active root depth, cm.

At the end of the experiment, plants were harvested and recorded. The water use efficiency was calculated by dividing the crop yield by the amount of seasonal evapotranspiration (Giriappa, 1983). The water economy was calculated by dividing the crop yield by the amount of water added as kg/m^3 (Talha *et al.*, 1980). The crop coefficient was calculated by dividing the actual evapotranspiration (ETa) by potential evapotranspiration (ETo), (Yaron *et al.*, 1973). Data were subjected to the analysis of variance according to Snedecor and Cochran (1989). The investment ratio was calculated as (IR) = Output LE / Input LE, (total costs), Rana *et al.* (1996).

RESULTS AND DISCUSSION

Aromatic and Medicinal Plant Yields

Data presented in table (6) show crop yield for the 3 cultivated plants and their economical components. The data indicate highly significant differences for Henbane, Echium and Achillea yields, and due to the either irrigation method or source of organic manure. The highest yields were obtained as a result of applying chicken manure. The magnitudes of crop yield values for irrigation were in the order of ½ hour, 2 liter/plant > ¾ hour, 3 liter/plant > ¼ hour, 1 liter/plant. As for the type of applied organic manure, the obtained order of chicken manure > peat moss > compost. Generally, chicken manure was responsible for about 28 to 57 % increase in plant total yields relative to the other manures, while the 2 liter/plant/day irrigation treatment increased the yield by about 10 to 25 % compared with the other irrigation treatments.

TABLE (6). Yield and yield components for Henbane, Echium and Achillea plants grown at El-Sheikh Zuwayid region.

Treatments		Egyptian Henbane				Echium (*Viper's*)				Achillea (*Yarrow*)			
Daily irrigation time	Organic manure	Plant weight (gm)	Seed weight, kg/feddan	Leaves weight, kg/feddan	Total yield, kg/feddan	100 seed weight (gm)	Seed weight, kg/feddan	Leaves weight, kg/feddan	Total yield, kg/feddan	Plant weight (gm)	Seed weight, kg/feddan	Leaves weight, kg/feddan	Total yield, kg/feddan
¼ hour, 1 liter/plant	Peat moss	560.00	26.18	3500.0	4480.00b	0.17	14.00	2800.0	3760.00	380.00	17.50	2100.00	3040.00
	Compost	525.00	23.80	3220.0	4200.00c	0.12	17.78	2420.0	3076.00	369.00	22.40	2380.00	2952.00
	C. M.	720.00	28.00	4200.0	5760.00a	0.20	21.00	3500.0	4828.00	487.00	26.60	2800.00	3896.00
Average		601.67	25.99	3640.00	4813.33c	0.17	17.59	2906.67	3888.00	412.00	22.17	2426.67	3296.00
½ hour, 2 liter/plant	Peat moss	700.00	32.73	4375.0	5600.00	0.22	17.50	3500.0	4700.00	475.00	21.88	2625.00	3800.00
	Compost	656.25	29.75	4025.0	5250.00	0.15	22.23	3225.0	3845.00	430.00	28.00	2975.00	3440.00
	C. M.	900.00	35.00	5250.0	7200.00	0.25	26.25	4375.0	6035.00	608.75	33.25	3500.00	4870.00
Average		752.08	32.49	4550.00	6016.67a	0.21	21.99	3700.00	4860.00	504.58	27.71	3033.33	4036.67
¾ hour, 3 liter/plant	Peat moss	632.80	29.58	3955.0	5062.40	0.20	15.82	3164.0	4248.80	429.40	19.78	2373.00	3435.20
	Compost	593.25	26.89	3638.6	4746.00	0.14	20.09	3038.6	3475.88	400.72	25.31	2689.40	3205.76
	C. M.	813.60	31.64	4746.0	6508.80	0.22	23.73	3955.0	5455.64	550.31	30.06	3164.00	4402.48
Average		679.88	29.37	4113.20	5439.07b	0.19	19.88	3385.87	4393.44	460.14	25.05	2742.13	3681.15
L.S.D.	I. T.			***	272.86			***	220.32			***	167.95
	O.M.			***	193.28			***	205.20			***	131.46
	Interaction			***	111.60			***	118.48			***	75.90

C. M. = Chicken manure, I.T. = Irrigation time, O.M. = Organic manure, Interaction = Between I.T. and O.M., *** = Significant at 0.001

These results are in agreement with the findings of Johnson and Hoyt (1999), Standberry and Bernstein (2000), Awadalla *et al.* (2002) and Shaxson and Barber (2003).

Actual Evapotranspiration (ETa)

The actual evapotranspiration is the combination of two processes, namely of evaporation from soil and plant surfaces and transpiration from plant. Results in tables (7 a, b and c) show highly significant differences among both irrigation times and types of organic manure fertilization, and their interactions. Also, the data show significant increase in water consumptive use for each of the investigated plants as a result of increasing irrigation time and fertilizing with chicken manure.

TABLE (7a). Monthly and seasonally actual evapotranspiration for Egyptian Henbane plant grown at El-Sheikh Zuwayid region.

Daily irrigation	Organic manure	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Avg.	Liter /plant /season	mm / day	mm/ season	m³/feddan /season	Total m³/feddan /season
		Liter / plant / day												
¼ hour, 1 liter/plant	Peat moss	0.33	0.47	0.75	1.46	1.68	1.70	1.32	1.14	198.98	2.17a	379.00	1591.82	1607.98
	Compost	0.30	0.46	0.75	1.45	1.64	1.67	1.27	1.12	195.34	2.13b	372.07	1562.69	1578.85
	C. M	0.35	0.49	0.80	1.46	1.68	1.72	1.40	1.16	203.01	2.21a	386.69	1624.12	1640.28
Average		0.33	0.47	0.76	1.46	1.67	1.70	1.33	1.14	199.11	2.17 c	379.26	1592.88	1609.04
½ hour, 2 liter/plant	Peat moss	0.42	0.59	0.97	1.90	2.01	2.08	1.76	1.42	248.87	2.71	474.03	1990.94	2007.10
	Compost	0.42	0.58	0.97	1.86	1.98	2.02	1.70	1.40	244.48	2.66	465.67	1955.83	1971.99
	C. M	0.43	0.60	0.98	1.90	2.03	2.13	1.82	1.44	252.64	2.75	481.22	2021.11	2037.27
Average		0.42	0.59	0.97	1.88	2.01	2.08	1.76	1.42	248.66	2.71 b	473.64	1989.30	2005.46
¾ hour, 3 liter/plant	Peat moss	0.43	0.63	1.01	1.94	2.03	2.19	1.85	1.47	257.23	2.80	489.97	2057.85	2074.01
	Compost	0.43	0.61	1.00	1.92	2.03	2.16	1.82	1.46	254.83	2.77	485.40	2038.66	2054.82
	C. M.	0.46	0.64	1.04	1.94	2.10	2.22	1.91	1.50	262.13	2.85	499.29	2097.02	2113.18
Average		0.44	0.63	1.01	1.93	2.05	2.19	1.86	1.47	258.06	2.81 a	491.55	2064.51	2080.67
L.S.D.	I. T.									***	0.05			
	O. M.									***	0.05			
	Interaction									***	0.03			

C. M. = Chicken manure, I. T. = Irrigation time, O. M = Organic manure,
Interaction = Between I.T. and O.M., *** = Significant at 0.001

TABLE (7b). Monthly and seasonally actual evapotranspiration for Echium plant grown at El-Sheikh Zuwayid region.

Daily irrigation	Organic manure	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Avg.	Liter /plant /season	mm / day	mm/ season	m³/feddan /season	Total m³/feddan /season
		Liter / plant / day												
¼ hour, 1 liter/plant	Peat moss	0.29	0.38	0.52	1.22	1.78	1.87	1.50	1.14	202.18	2.16b	385.10	1617.41	1627.97
	Compost	0.29	0.35	0.52	1.18	1.74	1.80	1.37	1.09	194.46	2.08c	370.40	1555.68	1566.24
	C. M.	0.29	0.35	0.54	1.22	1.89	1.87	1.58	1.16	205.77	2.20a	391.95	1646.19	1656.75
Average		0.29	0.36	0.53	1.21	1.81	1.85	1.49	1.13	200.80	2.15c	382.48	1606.42	1616.98
½ hour, 2 liter/plant	Peat moss	0.33	0.37	0.70	1.49	2.22	2.22	1.91	1.38	245.36	2.63	467.34	1962.85	1973.41
	Compost	0.33	0.37	0.69	1.45	2.19	2.16	1.88	1.35	240.92	2.58	458.90	1927.38	1937.94
	C. M.	0.33	0.38	0.71	1.51	2.24	2.44	1.97	1.43	255.15	2.73	485.99	2041.17	2051.73
Average		0.33	0.37	0.70	1.48	2.22	2.27	1.92	1.39	247.14	2.64b	470.75	1977.13	1987.69
¾ hour, 3 liter/plant	Peat moss	0.33	0.41	0.74	1.51	2.29	2.50	1.99	1.46	260.17	2.78	495.57	2081.38	2091.94
	Compost	0.33	0.39	0.72	1.51	2.26	2.47	1.99	1.45	257.88	2.76	491.20	2063.03	2073.59
	C. M.	0.33	0.42	0.74	1.55	2.33	2.50	2.05	1.48	264.01	2.83	502.88	2112.08	2122.64
Average		0.33	0.41	0.73	1.52	2.29	2.49	2.01	1.46	260.69	2.79a	496.55	2085.50	2096.06
L.S.D.	I. T.									***	0.05			
	O. M.									***	0.05			
	Interaction									***	0.03			

C. M. = Chicken manure, I. T. = Irrigation time, O. M. = Organic manure,
Interaction = Between I.T. and O.M., *** = Significant at 0.001

TABLE (7c). Monthly and seasonally actual evapotranspiration for Achillea plant grown at El-Sheikh Zuwayid region.

Daily irrigation	Organic manure	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Avg.	Liter /plant /season	mm / day	mm/ season	m³/feddan /season	Total m³/feddan /season
		Liter / plant / day												
¼ hour, 1 liter/plant	Peat moss	0.30	0.37	0.52	1.26	1.78	1.76	1.26	1.12	209.90	2.14b	399.81	1679.19	1691.51
	Compost	0.30	0.34	0.51	1.23	1.74	1.73	1.23	1.09	204.54	2.08 c	389.59	1636.29	1648.61
	C. M.	0.30	0.41	0.53	1.26	1.80	1.78	1.28	1.14	213.49	2.17 a	406.65	1707.94	1720.26
Average		0.30	0.37	0.52	1.25	1.77	1.76	1.26	1.12	209.31	2.13 c	398.68	1674.47	1686.79
½ hour, 2 liter/plant	Peat moss	0.33	0.37	0.71	1.47	2.22	2.22	1.82	1.42	264.66	2.70	504.11	2117.25	2129.57
	Compost	0.33	0.37	0.69	1.45	2.19	2.16	1.79	1.39	260.09	2.65	495.42	2080.76	2093.08
	C. M.	0.33	0.38	0.72	1.49	2.24	2.27	1.82	1.44	268.41	2.73	511.25	2147.27	2159.59
Average		0.33	0.37	0.71	1.47	2.22	2.22	1.81	1.41	264.39	2.69b	503.59	2115.09	2127.41
¾ hour, 3 liter/plant	Peat moss	0.33	0.41	0.76	1.51	2.29	2.33	1.85	1.47	274.76	2.80	523.36	2198.10	2210.42
	Compost	0.33	0.39	0.75	1.49	2.26	2.30	1.85	1.45	271.87	2.77	517.85	2174.95	2187.27
	C. M.	0.33	0.41	0.78	1.55	2.33	2.36	1.91	1.50	280.18	2.85	533.68	2241.44	2253.76
Average		0.33	0.40	0.76	1.52	2.29	2.33	1.87	1.47	275.60	2.81 a	524.96	2204.83	2217.15
L.S.D.	I. T.									***	0.05			
	O. M.									***	0.05			
	Interaction									***	0.03			

C. M. = Chicken manure, I. T. = Irrigation time, O. M. = Organic manure.
Interaction = Between I.T. and O.M., *** = Significant at 0.001

Obviously, the magnitudes of irrigation times were in the order of ¾ hour, 3 liter/plant > ½ hour, 2 liter/plant > ¼ hour, 1 liter/plant. For the types of applied organic manure the obtained order was chicken manure > peat moss > compost. These findings may be due to the increasing evaporation by adding organic manure to maintain the soil moisture for longer periods, thus increasing the available amount of soil moisture, which makes the rhizosphere a good reservoir for water utilization by plants. Similar results were obtained by Unger *et al.* (1988), Allen *et al.* (1998) and Moutonnet (2000).

Water Saving

The main target of this work is to adjust the proper irrigation regime by means of detecting the actual water consumption, which reflects the real water needs for plants. Table (8) shows the following values:

1- Proposed net irrigation water in m^3/feddan/day.
2- Proposed total irrigation water in m^3/feddan/season.
3- Gross irrigation water in m^3/feddan/season including nursery irrigation water and rainfall.
4- Actual evapotranspiration values in m^3/feddan/season.
5- Recommended irrigation water calculated as actual evapotranspiration with respect to irrigation efficiency in m^3/feddan/season.
6- Water loss as a product of subtracting of actual evapotranspiration and rainfall from gross irrigation water in m^3/feddan/season.
7- Beneficiary factor as percentage of water used in actual evapotranspiration to gross amount irrigation water.

From table (8) the following can be concluded;

a- One quarter hour irrigation time, 1 liter/day resulted in the lowest water loss values among all treatments for the investigated plants, so the highest beneficiary factor. However, under this condition, there is no excess of water to leach the salts away from the root zone as all applied water has been used for plants growth as detected by actual evapotranspiration. Therefore, it is expected that this treatment will cause the plants to suffer from salt accumulation around their roots, which could decrease plant growth.

b- The other two irrigation times, of 2 liter/day (½ hour/day) and 3 liter/day (¾ hour/day) led to considerable increase in water loss values, consequently small beneficiary factor, which indicate that some of the applied water was percolated from rhizosphere, especially from the high rate, 3 liter/day (¾ hour/day), which may result in leaching the fertilizers from the top soil.

c- Only the 2 liter/day (½ hour/day) treatment revealed close values to the traditional ones with drip irrigation efficiency (≈ 0.80 to 0.85), could maintain the opportunity to benefit from either water or fertilizers.

TABLE (8). Total applied, actual and modified irrigation water amounts for some aromatic and medicinal plants grown at El-Sheikh Zuwayid region.

Treatments		Egyptian Henbane						
Daily irrigation time	Organic manure	Proposed net irrigation m³/feddan /day	Total net irrigation m³/feddan /season	Gross irrigation m³/feddan /season	actual evapotranspiration m³/feddan /season	Recommended irrigation water m³/feddan /season	Water loss or gain m³/feddan /season	Beneficiary factor (Bf)
¼ hour, 1 liter/plant	Peat moss	8	1280	1691.89	1607.98	1891.74	-311.82	0.95
	Compost	8	1280	1691.89	1578.85	1857.47	-282.69	0.93
	C. M.	8	1280	1691.89	1640.28	1929.74	-344.12	0.97
Average		8	1280	1691.89	1609.04	1892.98	-312.88	0.95
½ hour, 2 liter/plant	Peat moss	16	2560	2971.89	2007.10	2361.29	569.06	0.68
	Compost	16	2560	2971.89	1971.99	2319.99	604.17	0.66
	C. M.	16	2560	2971.89	2037.27	2396.79	538.89	0.69
Average		16	2560	2971.89	2005.46	2359.36	570.70	0.67
¾ hour, 3 liter/plant	Peat moss	24	3840	4251.89	2074.01	2440.02	1782.15	0.49
	Compost	24	3840	4251.89	2054.82	2417.44	1801.34	0.48
	C. M.	24	3840	4251.89	2113.18	2486.09	1742.98	0.50
Average		24	3840	4251.89	2080.67	2447.85	1775.49	0.49

Irrigation period 160 days – Rainfall 395.73 m³/feddan - Nursery irrigation 16.16 m³/feddan.

Treatments		Echium (*Viper's Buglass*)						
¼ hour, 1 liter/plant	Peat moss	8	1280	1670.29	1627.97	1915.26	-337.41	0.97
	Compost	8	1280	1670.29	1566.24	1842.63	-275.68	0.94
	C. M.	8	1280	1670.29	1656.75	1949.12	-366.19	0.99
Average		8	1280	1670.29	1616.98	1902.33	-326.42	0.97
½ hour, 2 liter/plant	Peat moss	16	2560	2950.29	1973.41	2321.66	597.15	0.67
	Compost	16	2560	2950.29	1937.94	2279.93	632.62	0.66
	C. M.	16	2560	2950.29	2051.73	2413.80	518.83	0.70
Average		16	2560	2950.29	1987.69	2338.46	582.87	0.67
¾ hour, 3 liter/plant	Peat moss	24	3840	4230.29	2091.94	2461.11	1758.62	0.49
	Compost	24	3840	4230.29	2073.59	2439.52	1776.97	0.49
	C. M.	24	3840	4230.29	2122.64	2497.23	1727.92	0.50
Average		24	3840	4230.29	2096.06	2465.95	1754.50	0.50

Irrigation period 160 days – Rainfall 379.73 m³/feddan - Nursery irrigation 10.56 m³/feddan.

Treatments		Achillea millefalium (*Yarrow*)						
¼ hour, 1 liter/plant	Peat moss	8	1360	1742.45	1691.51	1990.01	-319.19	0.97
	Compost	8	1360	1742.45	1648.61	1939.54	-276.29	0.95
	C. M.	8	1360	1742.45	1720.26	2023.83	-347.94	0.99
Average		8	1360	1742.45	1686.79	1984.46	-314.47	0.97
½ hour, 2 liter/plant	Peat moss	16	2720	3102.45	2129.57	2505.37	602.75	0.69
	Compost	16	2720	3102.45	2093.08	2462.45	639.24	0.67
	C. M.	16	2720	3102.45	2159.59	2540.69	572.73	0.70
Average		16	2720	3102.45	2127.41	2502.84	604.91	0.69
¾ hour, 3 liter/plant	Peat moss	24	4080	4462.45	2210.42	2600.49	1881.90	0.50
	Compost	24	4080	4462.45	2187.27	2573.26	1905.05	0.49
	C. M.	24	4080	4462.45	2253.76	2651.49	1838.56	0.51
Average		24	4080	4462.45	2217.15	2608.41	1875.17	0.50

C. M. = Chicken manure, Irrigation period =170 days, Rainfall =370.13 m³/feddan, Nursery= irrigation 12.32 m³/feddan.

Water Use Efficiency of Plants (W.U.E.)

Data in table (9) shows a high increase in water use efficiency values for Henbane, Echium and Achillea plants as a result of ½ hour daily irrigation and fertilization by chicken manure. Results revealed that there was a great difference between irrigation times and types of applied organic manure. The magnitude of irrigation times were in the order of ½ hour, 2 liter/plant > ¼ hour, 1 liter/plant > ¾ hour, 3 liter/plant and for the types of organic manure were in the order of chicken manure > peat moss > compost.

TABLE (9). Water use efficiency (WUE) and water economy (W Eco.) for some aromatic and medicinal plants grown at El-Sheikh Zuwayid region.

Treatments		Egyptian Henbane		Echium (Viper's)		Achillea (Yarrow)	
Daily irrigation time	Organic manure	WUE (kg/m^3)	W Eco. (kg/m^3)	WUE (kg/m^3)	W Eco. (kg/m^3)	WUE (kg/m^3)	W Eco. (kg/m^3)
¼ hour, 1 liter/plant	Peat moss	2.79	2.65	2.31	2.25	1.80	1.74
	Compost	2.66	2.48	1.96	1.84	1.79	1.69
	Chicken manure	3.51	3.40	2.91	2.89	2.26	2.24
Average		2.99	2.84	2.40	2.33	1.95	1.89
½ hour, 2 liter/plant	Peat moss	2.79	1.88	2.38	1.59	1.78	1.22
	Compost	2.66	1.77	1.98	1.30	1.64	1.11
	Chicken manure	3.53	2.42	2.94	2.05	2.26	1.57
Average		3.00	2.02	2.44	1.65	1.89	1.30
¾ hour, 3 liter/plant	Peat moss	2.44	1.19	2.03	1.00	1.55	0.77
	Compost	2.31	1.12	1.68	0.82	1.47	0.72
	Chicken manure	3.08	1.53	2.57	1.29	1.95	0.99
Average		2.61	1.28	2.09	1.04	1.66	0.82

These results may be due to the high yields obtained under these conditions suggesting activation both in water and nutrient consumptions by plants, which affect crop yield. Similar results were obtained by Unger *et al.* (1988), Allen *et al.* (1998), Rizk (2002) and El-Dosouky *et al.* (2005).

Water Economy of Plants (W. Eco.)

Results in table (9) show the highest increase in water economy for Henbane, Echium and Achillea plants was obtained as a result of decreasing irrigation time and fertilization with chicken manure. All parameters have shown great differences between irrigation times and types of organic manure fertilization. The magnitude of irrigation times were in the order of ¼ hour, 1 liter/plant > ½ hour, 2 liter/plant > ¾ hour, 3 liter/plant and organic manure types were in the order of chicken manure > peat moss > compost.

These findings may be due to the saving of the stored soil moisture and also to the activation of both water and nutrient consumptions by plants, which gave high yields, thereby high water economy values. Similar results were obtained by Unger *et al.* (1988), Allen *et al.* (1998), Seidhom *et al.* (2002) and El-Dosouky *et al.* (2005).

Crop Coefficient (Kc)

The crop coefficient is useful in meeting the irrigation needs of crops and in the efficient utilization of the scarcely available and costly water in arid areas. It is also used in calculating irrigation programs. Results in tables (10 a, b and c) show similar trend for crop coefficients as to water consumptive use. The high increase in the crop coefficients for Henbane, Echium and Achillea plants are observed with increasing irrigation time and fertilization by chicken manure, indicate the great differences between irrigation times and types of organic manure. The magnitude of irrigation times were in the order of ¾ hour, 3 liter/plant > ½ hour, 2 liter/plant > ¼ hour, 1 liter/plant and for the types of added organic manure the order is chicken manure > peat moss> compost. These results may be due to increasing actual evapotranspiration by increasing soil moisture content with the addition organic manure and increasing soil water amount. Similar results were obtained by Doorenbos and Pruitt (1977) and Allen *et al.* (1998).

TABLE (10a). Crop coefficient (Kc) of Egyptian Henbane plant grown at El-Sheikh Zuwayid region.

Daily irrigation time	Organic manure	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Season Kc
¼ hour, 1 liter/plant	Peat moss	0.25	0.41	0.58	0.76	0.72	0.61	0.45	0.54
	Compost	0.23	0.40	0.58	0.75	0.70	0.60	0.43	0.53
	Chicken manure	0.27	0.42	0.62	0.76	0.72	0.62	0.48	0.56
Average		0.25	0.41	0.59	0.75	0.71	0.61	0.45	0.54
½ hour, 2 liter/plant	Peat moss	0.32	0.51	0.75	0.98	0.86	0.75	0.60	0.68
	Compost	0.32	0.50	0.75	0.96	0.85	0.73	0.58	0.67
	Chicken manure	0.33	0.52	0.76	0.98	0.87	0.77	0.62	0.69
Average		0.32	0.51	0.75	0.97	0.86	0.75	0.60	0.68
¾ hour, 3 liter/plant	Peat moss	0.33	0.54	0.78	1.00	0.87	0.79	0.63	0.71
	Compost	0.33	0.53	0.77	0.99	0.87	0.78	0.62	0.70
	Chicken manure	0.35	0.55	0.80	1.00	0.90	0.80	0.65	0.72
Average		0.34	0.54	0.78	1.00	0.88	0.79	0.63	0.71

TABLE (10b). Crop coefficient (Kc) of Echium plant grown at El-Sheikh Zuwayid region.

Daily irrigation time	Organic manure	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Season Kc
¼ hour, 1 liter/plant	Peat moss	0.23	0.33	0.41	0.63	0.77	0.68	0.51	0.51
	Compost	0.23	0.30	0.41	0.61	0.75	0.65	0.47	0.49
	Chicken manure	0.23	0.30	0.41	0.63	0.81	0.68	0.54	0.51
Average		0.23	0.31	0.41	0.62	0.77	0.67	0.51	0.50
½ hour, 2 liter/plant	Peat moss	0.25	0.32	0.54	0.77	0.95	0.80	0.65	0.61
	Compost	0.25	0.32	0.53	0.75	0.94	0.78	0.64	0.60
	Chicken manure	0.25	0.33	0.55	0.78	0.96	0.88	0.67	0.63
Average		0.25	0.32	0.54	0.77	0.95	0.82	0.65	0.61
¾ hour, 3 liter/plant	Peat moss	0.25	0.35	0.57	0.78	0.98	0.90	0.68	0.64
	Compost	0.25	0.34	0.56	0.78	0.97	0.89	0.68	0.64
	Chicken manure	0.25	0.36	0.57	0.80	1.00	0.90	0.70	0.65
Average		0.25	0.35	0.57	0.79	0.98	0.90	0.69	0.65

TABLE (10c). Crop coefficient (Kc) of Achillea plant grown at El-Sheikh Zuwayid region.

Daily irrigation time	Organic manure	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Season Kc
¼ hour, 1 liter/plant	Peat moss	0.23	0.32	0.40	0.65	0.76	0.63	0.43	0.49
	Compost	0.23	0.29	0.39	0.63	0.74	0.62	0.42	0.48
	Chicken manure	0.23	0.35	0.41	0.65	0.77	0.64	0.44	0.50
Average		0.23	0.32	0.40	0.65	0.76	0.63	0.43	0.49
½ hour, 2 liter/plant	Peat moss	0.25	0.32	0.55	0.76	0.95	0.80	0.62	0.61
	Compost	0.25	0.32	0.53	0.75	0.94	0.78	0.61	0.60
	Chicken manure	0.25	0.33	0.56	0.77	0.96	0.82	0.62	0.62
Average		0.25	0.32	0.55	0.76	0.95	0.80	0.62	0.61
¾ hour, 3 liter/plant	Peat moss	0.25	0.35	0.59	0.78	0.98	0.84	0.63	0.63
	Compost	0.25	0.34	0.58	0.77	0.97	0.83	0.63	0.62
	Chicken manure	0.25	0.35	0.60	0.80	1.00	0.85	0.65	0.64
Average		0.25	0.35	0.59	0.78	0.98	0.84	0.64	0.63

Economical Assessment

The economical evaluation is of a great importance. It depends on the net return from any agricultural process, which could encourage the consideration of the farmers shown by the values of investment ratio (IR) illustrated in table (11).

Referring to the obtained data, two groups of IR values are found. One group is based on the applied irrigation water and the other is based on the modified irrigation water according to actual evapotranspiration values. Generally, for both groups, chicken manure has the highest IR values, which reflects the highest benefit among all treatments under any irrigation regime particularly for the 2 liter/day (½ hr/day) application rate. The compost manure applications yielded the lowest IR values under the two options especially with the 1 and 3 liter/day application rates, while the 2 liter/day gave higher IR values in all cases. However, the results obtained for applying peat moss manure lies in the middle for both groups in which the 2 liter/day treatment overcame the 1 and 3 liter/day treatments. In addition, referring to the national IR value, which is around 1.25 LE for the given treatments, could be overcome with the two-irrigation regime options experimented in this study.

TABLE (11). Input and output items and the ascending rank of the investment ratio (IR) for some aromatic and medicinal plants grown at the El-Sheikh Zuwayid region.

Item	Plant type	Egyptian Henbane		
	Soil management	¼ hour, 1 liter/plant		
		Peat moss	Com-post	Chicken manure
List of Inputs	Soil mixing, LE/feddan	200	200	200
	Land preparation, LE/feddan	60	60	60
	Seeds, LE/feddan	200	200	200
	Cultivation, LE/feddan	60	60	60
	Irrigation, LE/feddan	423	423	423
	Modified irrigation, LE/feddan	473	464	482
	Organic fertilization, LE/fed.	1200	1200	1200
	Mineral fertilization, LE/fed.	150	150	150
	Weed control, LE/feddan	60	60	60
	Pest control, LE/feddan	60	60	60
	Labors costs, LE/feddan	60	60	60
	Machines, LE/feddan	60	60	60
	Fuel, LE/feddan	100	100	100
	Harvesting, LE/feddan	60	60	60
	Crop transportation, LE/fed.	40	40	40
	Rent (on season), LE/feddan	300	300	300
	Total input, LE/feddan	3033	3033	3033
	Modified total input, LE/fed.	3083	3074	3092
List of Outputs	Yield, kg/feddan	4480	4200	5760
	Price, LE/kg	2.0	2.0	2.0
	Total price, LE/feddan	8960	8400	11520
	Net income, LE/feddan	5927	5367	8487
	Modified net income, LE/feddan	5877	5326	8428
Investment ratio (IR)		2.95	2.77	3.80
Modified investment ratio (IR)		2.91	2.73	3.73
Initial IWA m^3/feddan		1692	1692	1692
Water price, LE/m^3		0.25	0.25	0.25
Modified IWA m^3/feddan		1892	1857	1930

Ascending rank: Initial Rank	Ascending rank: Initial IR, LE	Treatments: Daily irrig.	Treatments: Organic manure	Ascending rank: Modif. Rank	Ascending rank: Modif. IR, LE	Treatments: Daily irrig.	Treatments: Organic manure
Egyptian Henbane							
1	2.58	3 L	Compost	1	2.73	1 L	Compost
2	2.76	3 L	Peat moss	2	2.91	1 L	Peat moss
3	2.77	1 L	Compost	3	2.95	3 L	Compost
4	2.95	1 L	Peat moss	4	3.14	3 L	Peat moss
5	3.13	2 L	Compost	5	3.29	2 L	Compost
6	3.34	2 L	Peat moss	6	3.50	2 L	Peat moss
7	3.54	3 L	C. M.	7	3.73	1 L	C. M.
8	3.80	1 L	C. M	8	4.03	3 L	C. M.
9	4.29	2 L	C. M	9	4.49	2 L	C. M.
Echium (Viper's Buglass)							
1	1.86	3 L	Compost	1	1.96	1 L	Compost
2	1.99	1 L	Compost	2	2.11	3 L	Compost
3	2.25	2 L	Compost	3	2.37	2 L	Compost
4	2.27	3 L	Peat moss	4	2.38	1 L	Peat moss
5	2.43	1 L	Peat moss	5	2.58	3 L	Peat moss
6	2.75	2 L	Peat moss	6	2.88	2 L	Peat moss
7	2.92	3 L	C. M.	7	3.05	1 L	C. M.
8	3.12	1 L	C. M.	8	3.30	3 L	C. M
9	3.53	2 L	C. M.	9	3.68	2 L	C. M.
Achillea millefalium (Yarrow)							
1	1.71	3 L	Compost	1	1.90	1 L	Compost
2	1.83	3 L	Peat moss	2	1.94	1 L	Peat moss
3	1.93	1 L	Compost	3	1.96	3 L	Compost
4	1.98	1 L	Peat moss	4	2.09	3 L	Peat moss
5	2.02	2 L	Compost	5	2.12	2 L	Compost
6	2.23	2 L	Peat moss	6	2.33	2 L	Peat moss
7	2.35	3 L	C. M.	7	2.48	1 L	C. M.
8	2.54	1 L	C. M.	8	2.67	3 L	C. M.
9	2.86	2 L	C. M.	9	2.98	2 L	C. M.

C. M. = Chicken manure, IWA = Irrigation water applied, irrig = irrigation,
IR = investment ratio.

CONCLUSION

The following can be concluded from the aforementioned discussion:

Chicken manure is responsible for the highest productivity and returns investment under any water regime along with the 2 liter/day (½ hr/day) treatment. The empirical averages for Kc values from the experiment for the studied plants are 0.64, 0.59 and 0.58 for Egyptian Henbane, Echium and Achillea, respectively.

REFERENCES

Ahmed, Amal A. E. M. (1999). Studies on some factors affecting heat capacity of some Egyptian desert soils. *M.Sc. thesis, Fac. Sci., Cairo Univ., Egypt.*

Allen, R.G.; L.S. Pereira; D. Raes and M. Smith (1998). In "*Crop evapotranspiration. Guidelines for computing crop water requirements*". Irrig. and Drain. Paper, No. 56, FAO, Rome, Italy.

Amirghofran, Z.; M. Azadbakht and F. Keshavarzi (2000). Echium amoenum stimulate of lymphocyte proliferation and inhibit of humoral antibody synthesis. *Iranian Journal of Medicinal Science,* 25 (3 and 4): 119-124.

Awadalla, S.Y.; K.Y. Khalil, and Bothaina, F. Abd El-Ghani (2002). Field composts as a way to combat salinization of cultivated desert soils. *Proceedings Int. Symp. On Optimum Resources Utilization in Salt-Affected Ecosystems in Arid and Semi Arid Regions, Cairo*, 8-11 Apr., 2002: 112-122.

Biondi, S. and S. Fornale (2000). In *"Jasmonates induce over-accumulation of methylputrescine and conjugated polyamines in Hyoscyamus muticus L. root cultures".* Plant Cell Reports, June 19, : 691-697. (Dipartimento di Biologia, Universita di Bologna, Via Irnerio 42, I- 40126, Bologna, Italy).

Chevallier, A. (1996). In "*The Encyclopaedia of Medicinal Plants*". *Dorling Kindersley, London.*

Doorenbos J. and W.O. Pruitt (1977). In "*Crop water requirements*". Irrig. & Drain. Paper No. 24, FAO, Rome, Italy.

El-Dosouky, M. H.; A. H. Ibrahim; M. N. Khalil and S. H. Seidhom (2005). Water use efficiency and water economy of olive orchards as affected by soil heat at Sinai. *Meteorology Research Bulletin ISSN* 1687-1014, Vol. 19, 2004, : 124-146. *Egyptian Meteorological Authority, Cairo, Egypt.*

El-Sersawy, M. M. and S.Y. Awadalla (1993). Evaluating organic waste amelioration of calcareous soil through thermal changes. *Egypt. J. App. Sci.*, 8 (3): 809-824.

Fanous, N. E. and M. I. Mikhail (1997). Water and soil organic management for wheat cultivated in the newly reclaimed desert area. *Egypt. J. Appl. Sci.*, 12 (8): 298-315.

Giriappa, S. (1983). Water use efficiency in agriculture: Agricultural development and rural transformation unit. *Proceedings Int. Conf. for Social and Economic Change, Bangalore, Oxford, IBH Publ. Co., U.K.*

Grigson, G. (1996). In "*The Englishman's Flora*". (2nd ed.), Helicon Publishing, Oxford.

Haynes, R. J. and R. Naidu (1998). Influence of lime, fertilizer and manure applications on soil organic content and soil physical conditions. *Nutrient - Cycling in agroecosystems*, 51(2): 123-137.

Ismail, M. H. Z. (1999). Rising the productivity of newly reclaimed soil through maximizing the profitability of agricultural wastes and some natural sediments. *M.Sc. thesis, Fac. Agric., Zagazig Univ., Egypt.*

Johnson, A. M. and G.D. Hoyt (1999). Changes to the soil environment under conservation tillage. *Hort. Technology*, 9 (3): 380-393.

Kirda, C. (2000). In "*Deficit irrigation scheduling based on plant growth stages showing water stress tolerance: Deficit Irrigation Practices*". Water Reports, No. 22, FAO. Rome, Italy.

Lapinskas, P. (2000). In "*Omega-6 fatty acids – What, why, where and how? presented at a fitter future for fats*". June 6th 2000. Leatherhead Food Research Association. Leatherhead, England.

Mateus, L. and S. Cherkaoui (2000). Simultaneous determination of scopolamine, hyoscyamine and littorine in plants and different hairy root clones of Hyoscyamus muticus by micellar electrokinetic chromatography. *Phytochemistry Oxford*, June, 54 (5): 517-523.

Mikhail, M. I. (1997). Effect of some organic ameliorants on some soil properties and plant growth. *Egypt. J. Appl. Sci.*, 12 (8): 609-620.

Moutonnet, P. (2000). In "*Yield response factors of field crops to deficit irrigation: Deficit Irrigation Practices*". Water Reports No. 22, FAO, Rome, Italy.

Newall, C. A.; L. A. Anderson and J. D. Phillipson (1996). In "*Herbal Medicines: A Guide for Health-care Professionals*". The Pharmaceutical Press, London.

Rana, G.; N. Katerji; M. Mastrorilli; C. R. Camp; E. J. Sadler and R. E. Yoder (1996). Evapotranspiration measurement of crops under water stress: Evapotranspiration and irrigation scheduling. *Proceedings of the International Conference, San Antonio, Texas, U.S.A., November 3-6*: 691-696.

Richards, L.A. (1954). In "*Diagnosis and improvement of saline and alkali soils*". Agric. Hand Book No. 60. U.S. Salinity Lab. Staff, Washington D.C., U.S.A.

Rizk, Evon K. (2002). Evaluation of crop water use efficiency for some varieties of Sudanese and Egyptian cowpea and its relation to productivity. *Ph.D. thesis, Department of Natural Resources, Institute of African Research and Studies, Cairo Univ., Egypt.*

Seidhom, S. H.; A. M. Talaat and G. Abdel-Rahman (2002). Environmental factors affecting soil heat and water use efficiency of faba bean in the newly reclaimed area of El-Salheia. *Egypt. J. Appl. Sci.*, 17 (10): 884-907.

Shaxson F. and R. Barber (2003). In "*Optimizing Soil Moisture for Plant Production*". FAO Soils Bulletin No. 79, FAO, Rome, Italy.

Smith, M. (1992). In "*CROPWAT: A computer program for irrigation planning and management*". Irrig. and Drain. Paper No. 46, FAO, Rome, Italy.

Snedecor, G.W. and W. G. Cochran (1989). In "*Statistical Methods*". 7th ed., Iowa State Univ. Press, Ames, Iowa, U.S.A., 593 pp.

Standberry, L. R. and D. I. Bernstein (Eds) (2000). In "*Sexually Transmitted Diseases: Vaccines, Prevention and Control*". Academic Press, San Diego, San Francisco, New York, Boston, London, Sydney, Tokyo, 468 pp.

Talha, M.; M. A. Aziz and E. M. El-Toni (1980). The combined effect of irrigation intervals and cycocel treatments on *Pelargonium Graveolens* L. II-Evapotranspiration and water economy. *Egypt. J. Soil Sci.*, 20 (2): 121.

Unger, P.W.; O.R. Jones and J. L. Steiner (1988). In "*Drought Research Priorities for the Dryland Tropics*: Principles of crop and soil management procedures for maximizing production per unit rainfall"., p. 97-112.

Viale Delle Terme Di Caracalla (2003). In "*Fertilizer use by crop in Poland*". First version, FAO, Rome, Italy.

Yaron, B.; E. Danfors and Y. Vaadia (1973). In *"Arid Zone Irrigation"*. Springer Verlage, Berlin, Heidelberg, New York.

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الاحتياجات المائية للمحاصيل تحت ظروف شمال سيناء: ١- زمن الري والتسميد العضوي لتحسين كفاءة استخدام بعض النباتات الطبية والعطرية للمياه.

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يهدف هذا البحث إلى دراسة أثر إدارة المياه من خلال أزمنة الرى ونوع السماد العضوى والتفاعل بينهما على بعض النباتات الطبية والعطرية وعلى ترشيد استهلاك مياه الرى وكفاءة استخدام النباتات للمياه واقتصاديات المياه تحت ظروف الري بالتنقيط في الأراضي الرملية الصحراوية بمحافظة شمال سيناء بمصر.

أقيمت التجربة بمزرعة محطة بحوث الشيخ زويد بشمال سيناء وتضمنت التجارب ثلاثة أزمنة رى بكميات مياه ري مختلفة ٢ و٤ و٦ لتر/م٢ كالتالى (ربع ساعة = ١ لتر/نبات/يوم) & (نصف ساعة = ٢ لتر/نبات/يوم) & (ساعة إلا ربع = ٣ لتر/نبات/يوم) ، وثلاثة أنواع سماد عضوى (بيتموس & كمبوست & سماد دواجن) ولأربع مكررات لتصميم قطع منشقة مرة واحدة خلال موسم ٢٠٠٣ / ٢٠٠٤ ، وقد تم تحليل النتائج إحصائيا وكانت النتائج كما يلى:

١- زيادة معنوية للمحصول وكفاءة استخدام المحصول للمياه ومعدل الاستثمار (عائد الجنيه) بالرى بزمن نصف ساعة يوميا (= ٢ لتر/نبات/يوم) مع التسميد بسماد الدواجن، ونقص معنوي للاستهلاك المائي ومعامل المحصول بنقص زمن وكمية الري مع التسميد بالكمبوست. وزادت اقتصاديات مياه الري بنقص زمن الرى مع التسميد بسماد الدواجن.

٢- بالنظر الى الاستهلاك المائي والتقييم الإقتصادى لكل المعاملات نجد أن الرى ٢ لتر/ ساعة يوميا / نبات أعطى أعلى ربحية. بينما أدى معدل الرى ربع ساعة يوميا / نبات الى تراكم الأملاح فى منطقة الجذور، كذلك الرى ساعة إلا ربع يوميا / نبات الى غسيل الأسمدة والمغذيات بعيدا عن منطقة الريزوسفير مما قلل من نمو المحاصيل.

٣- التسميد بسماد الدواجن أظهر أعلى إنتاجية وعائد تحت أى نظام مائى مع تفوق معاملة الرى نصف ساعة يوميا (= ٢ لتر/نبات/يوم).

٤- كان معامل المحصول التجريبى الموسمى ٠,٦٤ ، ٠,٥٩ ، و ٠,٥٨ لكل من نباتات السكران المصرى ، والأكيم ، والإشيليا على الترتيب.

وقد أوصت الدراسة بالرى بالتنقيط (نقاط ٤ لتر / ساعة) لمدة نصف ساعة يوميا مع إضافة السماد العضوي بمعدل ٢٠ م٣/فدان (سماد دواجن) سنويا للأراضي الرملية لزيادة المحصول وكفاءة استخدام المحصول للمياه ومعدل الاستثمار وذلك تحت الظروف المشابهة لمنطقة الدراسة.