EFFECT OF IRRIGATION WATER QUANTITY AND APPLICATION OF COMPLETE FERTILIZER AS FERTIGATION METHOD ON SOME ORNAMENTAL PLANTS UNDER ARISH CONDITIONS

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ABSTRACT

Two field experiments were carried out during two successive seasons of 2002 and 2003 at the Experimental Farm of the Faculty of Environmental Agriculture Science, El-Arish, Suez Canal University to study the effect of irrigation water quantity and different rates of complete fertilizer on the growth rate, flowering characters and plant nutritional for *Tagetes erecta* L., *Zinnia elegans* J. and *Gomphrena globosa* L. plants.

The obtained results showed in most cases that application of irrigation water at level of (800 m^3/fed.) being the most effective and favorable treatment on increasing plant growth rate and flowering characters per plant and unit area. That was followed by irrigation water with (600 m^3/fed.) while, application of the lowest level of irrigation water (400 m^3/fed.) being recorded the minimum values.

On the other hand, application of complete fertilizer (Sangeral) at the rates of 0.5, 1.0 and 1.5% through irrigation water (fertigation methods) recorded the maximum values of plant growth rate and flowering characters but without significant differences between them in most cases. Whereas, application of complete fertilizer (0.1%) being the superior treatment regarding total carbohydrates and plant nutritional status (N, P and K content), while the lost rate (0.5%) showed the minimum values in this respect. The interaction between the two factors of study in general, reflect significant effect on most studied parameters except few characters which were fluctuated in the two seasons.

Key words: Irrigation water quantity, complete fertilizer, fertigation method.

INTRODUCTION

The African marigold (*Tagetes erecta* L.) is grown in the open field as a back ground for annual flowers in the gardens, as cut flowers, besides it has also medicinal uses, (Szabo and Papp 1975).

Zinnina (*Zinnia elegans* J.) is one of the most useful flowering annuals for gardens . It can be used in flower bed, borders and as a cut flower. The two plants belong to family Asteraceae and are grown in summer months. Globe amaranth (*Gomphrena globosa* L.) Family Amaranthaceae is one of flowering annuals bedding plants usually used as a source of colors in the gardens in addition to its easy retaining the shape and colour winter and dry arrangements.

Productivity of plants under the conditions of sandy soil depend on application of the optimum quantity of irrigation water and fertilizers rate as well as, choosing the suitable method of fertilizer application. Moreover, previous studies reported that increasing soil moisture content and /or irrigation water quantity in sand soil greatly promoted the growth rate and the productivity of various ornamental plants.

It has been proved, particularly in the recent time, that for reaching maximum utilization efficiency of fertilizer and further increase of crop yields under sandy soil conditions, it can be achieved by possible means such as fertigation frequency, suitable fertilizers and adequate quantity of irrigation water. Advantage resulting from fertigation technique, by reducing the amount of fertilizer and interval between applications. Through this technique it is possible to maintain uniform level of nutrients and to control the nutrient supply in the soil in accordance with changing plants needs during the growth seasons (Sterling 1983).

Fertigation increased the availability of nutrient near the root zoon with a reduction in leaching losses. Therefore, more growth of tuberose plants can be expected with fertigation having N P K and /or supplemented with micronutrients compared with normal fertilizer (Munikrishnap *et al.*2002) they added that application fertilizers through irrigation produced significantly higher vegetative parameters (plant height, number of tillers, leaf area, etc.), flowering parameter (days required for flowering and duration of flowering, spike and rachis length, diameter of floret, number of spike lets and spikes and florets) and cumulative flower yield /ha.

Therefore, the aim of this work was to study the influence of irrigation water quantity and application of different levels of complete fertilizer through the drip irrigation system (fertigation) on the growth rate, flowering character and some chemical constituents for *Tagetes erecta* L., *Zinnia elegans* J. and *Gomphrena globosa* L. plants.

MATERIALS AND METHODS

This work was conducted during the two successive summer seasons of 2002 -2003 under the conditions of sandy soil at the Experimental Farm of the Faculty of Environmental Agriculture Science, El-Arish, Suez Canal University. The objective of this investigation was to study the influence of irrigation water quantity and application of different levels of complete fertilizer through the drip irrigation system (fertigation) on the growth rate, flowering character and some chemical constituents for *Tagetes erecta* L., *Zinnia elegans* J. and *Gomphrena globosa* L. plants.

This experiment included 12 treatments which were the combinations between three irrigation water quantities; i.e., 400, 600 and 800 m^3/fed., and four rates of complete fertilizer used contained macro and micro nutrients with commercial name of (Sangeral) consists of macro elements, total nitrogen 20% N (4.4% Ammonia – 5.8% Nitrate – 9.8% Urea), Phosphorus (20%P_2O_5), Potassium (20% K_2O), Mg (0.012%) Sulphur (0.04%) and microelements (as ppm) Fe (70), Zn (14), Cu (13), Mn (13), B (12) and Mo (12). The concentrations of complete fertilizer in the two seasons were zero, 0.5% , 1.0 and 1.5%. These later three treatments were added as fertigation until the beginning of the flowering stage.

These treatments were arranged in a split plot design with three replicates. The irrigation water quantities were randomly distributed in the main plot, while, the rates of fertilizers were in the sub plots. The area of experimental unit was 12.60 m^2 contain three dripper irrigation lines with 6 m in length and 70 cm. in width. One dripper line was used for measuring vegetative growth characters, while the other two lines were used for flowering characters. A guard area (1.5 m wide) was left between the experimental units to avoid the overlapping infiltration of irrigation. Seeds of *Tagetes erecta* L., *Zinnia elegans* J,. and *Gomphrena globosa* L. plants were sown on February 27th during both seasons in plastic pots of 40 cm. diameter. The seedlings of a uniform size were transplanted to the field on March 29th during 2002 and 2003 seasons.

Drip irrigation system was used as a modified method of irrigation. The dripper lines with discharge of 1.3 L/h for each dripper at 1 bar were used. All experimental plots received equal amount of water during transplanting stage till 20 days from transplanting. The

irrigation treatments started on 26 April in both seasons to study irrigation water quantity (m^3/fed.), number of irrigations, time and amount of water at every irrigation (m^3/fed. and/plot) during all growth stages of *Tagetes erecta*, *Zinnia elegans* and *Gomphrena globosa* plants are shown in Schedule (1). The fertilizer rates (0 , 0.5, 1.0 and 1.5%) were added through irrigation water weekly beginning 20 days after transplanting for eight times. The other normal agricultural treatments for growing were practiced. At the full open of the flower for *Tagetes erecta*, *Zinnia elegans* and *Gomphrena globosa*, the following data were recorded:

1- Vegetative growth: plant height (cm), number of shoot /plant, shoot length (cm), fresh and dry weight / plant (g) and fresh and dry weight of roots / plant (g).

2- Flowering characters: the flowering date (time from the final transplanting to showing the first flower in days), flowering period (days), inflorescence diameter (cm), inflorescence number /plant and vase life (days).

3- Chemical analysis of leaves: The total carbohydrates content were determined according to Smith *et al.* (1958). Nitrogen content was determined by the distillation in micro-Kjeldahl method (Black 1965); phosphorus and potassium determination according to Olsen and Sommers (1982) and Jackson (1970), respectively.

Schedule 1. Irrigation water quantity, number of irrigation, time of every irrigation and amount of water at every irrigation during the growth stages of *Tagetes erecta*, *Zinnia elegans* and *Gomphrena globosa* plants.

Irrigation water quantity (m^3/fed.)	Number of irrigation	Time of every irrigation (minute)	Amount of water at every irrigation (m^3/plot 12.6m^2)	(m^3/fed.)
400	46	30	0.026	8.667
600	46	45	0.039	13.000
800	46	60	0.052	17.333

The physical and chemical soil characteristics and chemical analysis of well irrigation water used are shown in Tables (1 and 2), as described by Piper (1950).

Statistical analysis of variance was calculated according to Snedecor and Cochran(1980), Means separation was done according to L.S.D. at 0.05 level.

Table (1): Mechanical and chemical analysis of the soil in both Seasons.

	2002	2003
Mechanical analysis		
Coarse	27.95	27.90
Fine sand%	62.05	61.60
Silt%	7.00	7.05
Clay%	3.00	3.10
Soil texture	Sandy	Sandy
Chemical analysis		
	meq/L	
Ca^{++}	1.20	1.60
Mg^{++}	0.90	1.00
Na^{+}	22.00	21.10
K^{+}	0.60	0.68
Cl^{-}	23.10	22.90
CO_3^{--}	-	-
HCO_3^{-}	0.87	0.85
SO_4^{--}	0.73	0.75
EC dSm^{-1}	2.47	2.45
pH	8.27	8.63
$CaCO_3$%	0.16	0.20
$CaCO_3$%	3.06	3.06

Table (2): Chemical analysis of the used water irrigation in both seasons.

Ca^{++}	(meq/L)	10.60
Mg^{++}	,,	5.80
Na^{+}	,,	32.70
K^{+}	,,	0.98
Cl^{-}	,,	40.50
CO_3^{--}	,,	,,
HCO_3^{-}	,,	5.68
SO_4^{--}	,,	3.90
EC dSm^{-1}	,,	5.00
Concentration ppm		3200

RESULTS AND DISCUSSION

1- Vegetative growth characters:

a. Effect of irrigation water quantity:

Data presented in Table (3) show that increasing irrigation water supply exerted a marked and significant effect on all studied growth characters. Whereas, the maximum values of these characters were more distinct with application of irrigation water at 800 and 600 m^3/fed. in the first and second seasons, respectively. Moreover, application of the relatively highest level of water supply 800 m^3/fed. came in the first rank in this respect in both seasons. In this connection, the promoting effect with increasing water supply up to 600 m^3 and or 800 m^3/fed. on the growth rate may be due to the greatest role of water on all internal physiological metabolic processes in the plant. On the contrary, decreasing soil moisture content and /or application of lowest level of irrigation water 400 m^3/ fed. being the inferior one on all the

Table (9): Effect of irrigation water quantity on some flowering characters of *Tagetes erecta, Zinnia elegans and Gomphrena globosa* plants during 2002 and 2003 seasons.

Treatments Irrigation water quantity (m^3/fed.)	Days to first flower open		Flowering period (days)		Inflorescence diameter (cm)		Shoots Number /plant		Number of flowers / plant		Vase-life (days)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Tagetes erecta plants												
400	31.6	30.1	47.5	51.0	3.37	3.95	7.92	8.00	8.66	8.86	6.0	6.3
600	35.5	34.8	51.9	56.0	3.68	3.85	8.75	9.33	9.33	9.66	8.6	8.9
800	37.2	36.9	57.8	61.0	4.10	4.57	10.08	10.67	11.36	10.68	11.7	12.0
L.S.D. 0.05	2.4	2.6	2.8	3.0	0.19	0.20	1.67	1.78	2.13	2.23	1.5	1.5
Zinnia elegans plants												
400	27.9	27.1	42.3	44.0	4.52	4.85	6.50	6.67	7.40	7.33	5.8	5.0
600	30.5	30.2	46.8	48.0	4.63	4.90	8.08	8.67	9.33	8.66	6.4	7.0
800	32.8	32.3	52.3	52.9	4.90	5.55	10.36	9.33	11.66	10.33	7.1	7.7
L.S.D. 0.05	1.9	2.0	1.7	1.9	0.07	0.09	0.93	0.95	1.02	0.91	0.3	0.3
Gomphrena globosa plants												
400	20.8	19.9	75.7	78.3	2.41	2.44	22.08	23.67	24.69	23.95	7.2	7.5
600	23.6	23.1	86.3	89.5	2.40	2.43	23.75	24.37	27.36	26.89	9.4	9.5
800	24.8	24.3	97.7	96.7	2.61	2.67	26.58	26.36	31.83	29.46	10.7	10.6
L.S.D. 0.05	1.2	1.5	0.7	0.9	0.05	0.05	0.51	0.54	5.14	4.64	1.3	1.1

increase in flower diameter or flower number or both as reported by Devit *et al.* (1991).

b- Effect of fertilizer rates:

The obtained data in Table (10) indicated that the highest increment of flowering characters were recorded by application of complete fertilizer through irrigation water (fertigation), as compared with control treatment. The highest values of the flowering characters were achieved with increasing level of fertilizer through fertigation in the two seasons. On the contrary, increasing the addition of fertilizer up to the highest rate (1.5%) delayed the initiation of flowering, increasing flowering period and vas-live in the three types studies. The promoting effect of addition the complete fertilizers at high rates on the flowering characters may be explained that the macro and microelements are essential to develop more vegetative growth on the account of formation and development of flowering character. These results are in agreement with the findings of El-Tarawy and Menesi (1989) on both *Tagetes erecta* and *Zinnia elegans* plants, El-Mahrouk *et al.* (1992) on *Helipterum roseum* and *Delphinum ajacus* and Kandeel *et al.* (2002) on *Chrysanthemum parthenium* who mentioned that the highest number of inflorescences per plant, inflorescence diameter and fresh and dry weights of inflorescences per plant were obtained by high fertilizer rate. Rubinber and Kumar (1998) on pansy and (Munikrishnap *et al.*,2002) indicated that fertigation without micronutrient have no effect while, fertigation with 80% NPK supplementation with 0.1% B or 0.5% Zn can be effectively adopted for proper growth of tuberose.

c-Effect of interaction between irrigation water quantity and fertilizer rates:

Table (11) indicated that high quantity of irrigation water (800 m^3/fed.) and fertigated with high rates of complete fertilizer (0.1 and 1.5%) had a great influence on flowering characters comparing with irrigation without fertilizer. The interaction between complete fertilizer and all water quantity caused an increase in flowering characters compared to that control treatment. These results are in line with those stated by Barham *et al.* (1986) on violet, Khattab *et al.*(2002) on *Salvia splendens.*

Finally, from the forgoing results and discussion, it could be noticed that the growth rate and flowering behavior of *Tagetes erecta*, *Zinnia elegans* and *Gomphrena globosa* plants varied according to the irrigation water quantity and the used rates of complete fertilizer.

Table (10): Effect of complete fertilization on some flowering characters of *Tagetes erecta, Zinnia elegans and Gomphrena globosa* plants during 2002 and 2003 seasons.

Treatments / Fertilization	Days to first flower open		Flowering period (days)		Inflorescence diameter (cm)		Shoots number /plant		Number of flowers / plant		Vase-life (days)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Tagetes erecta plants												
Control	30.9	29.5	42.0	44.0	3.33	3.54	5.22	5.67	6.00	5.36	6.3	6.7
0.5%	33.6	32.8	50.7	52.4	3.46	3.65	8.56	9.33	9.68	9.33	7.4	7.7
1.0%	35.8	35.4	54.2	56.7	3.86	4.03	10.00	11.00	10.66	11.36	8.1	8.3
1.5%	36.7	36.4	62.7	65.2	4.22	4.67	11.89	12.34	12.38	12.33	9.6	10.0
L.S.D. 0.05	3.0	3.1	3.2	3.7	0.22	0.25	1.93	1.98	1.33	1.25	1.7	1.9
Zinnia elegans plants												
Control	27.1	25.9	39.8	40.2	4.00	4.33	5.78	6.00	7.00	6.66	5.4	5.7
0.5%	30.1	29.6	46.7	48.7	4.33	4.67	7.11	7.67	8.36	8.69	6.0	6.3
1.0%	32.2	31.4	49.7	50.3	5.02	5.33	10.33	9.99	10.86	11.00	6.8	7.0
1.5%	32.9	32.1	52.3	54.3	5.50	5.60	12.56	11.01	12.36	11.36	7.5	7.7
L.S.D. 0.05	2.2	2.5	2.0	2.4	0.09	0.10	2.12	1.10	1.12	1.24	0.3	0.3
Gomphrena globosa plants												
Control	20.9	20.2	62.7	65.3	2.31	2.33	20.89	21.00	23.66	22.96	7.4	6.2
0.5%	24.6	24.1	72.7	74.7	2.38	2.37	22.78	22.89	25.68	26.46	9.5	8.3
1.0%	26.8	26.2	88.3	90.3	2.47	2.48	24.67	25.33	27.33	28.36	10.0	9.7
1.5%	28.6	28.4	95.7	98.3	2.73	2.79	28.22	29.33	31.37	33.68	10.5	10.6
L.S.D. 0.05	3.3	4.4	0.9	1.0	0.12	0.12	0.59	0.60	6.21	5.42	1.3	1.0

Table (5): Effect of irrigation water quantity, complete fertilization and their interaction on some growth characters of *Tagetes erecta*, *Zinnia elegans* and *Gomphrena globosa* plants during 2002 and 2003 seasons.

Treatments		Plant height (cm)		No. of shoots /plant		Shoot length (cm)		Fresh weight /plant (g)		Dry weight /plant (g)		Fresh weight of roots /plant (g)		Dry weight of roots /plant (g)	
Irrigation water quantity (m^3/fed.)	fertilization	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Tagetes erecta plants															
400	Control	35.53	36.49	5.17	5.33	13.43	13.67	34.53	35.06	8.90	9.00	4.30	4.63	1.47	1.50
	0.5 %	43.47	44.99	5.67	5.69	17.47	17.97	43.67	45.37	11.31	12.87	5.03	5.69	2.63	2.79
	1.0%	45.47	46.47	7.17	7.67	19.30	21.34	51.24	53.70	14.31	16.37	5.33	6.25	2.84	2.85
	1.5 %	50.40	54.33	8.33	8.67	22.07	23.34	69.57	71.00	16.93	20.49	6.47	7.26	3.12	3.36
600	Control	40.47	41.47	6.67	6.67	16.87	17.14	41.43	42.96	10.41	10.68	5.13	5.84	2.26	2.43
	0.5 %	44.37	45.98	6.17	6.33	19.33	20.12	54.73	55.00	14.55	15.99	6.13	7.65	2.73	2.97
	1.0%	46.23	48.08	7.33	7.67	21.67	23.67	59.47	60.16	16.39	17.59	6.43	7.25	3.17	3.54
	1.5 %	52.47	54.68	8.67	9.13	25.67	26.69	73.57	75.32	26.56	27.96	7.17	9.06	3.45	3.63
800	Control	43.57	46.13	6.33	6.67	20.37	21.54	54.57	56.68	13.48	13.99	5.97	6.03	1.83	1.86
	0.5 %	47.37	50.11	6.33	7.17	24.27	25.37	61.74	62.99	18.60	19.24	7.13	8.43	2.91	3.03
	1.0%	52.43	54.76	8.33	8.67	27.17	29.34	69.75	71.24	22.29	24.66	8.57	9.55	3.27	3.59
	1.5 %	55.77	57.02	9.17	9.67	29.40	31.67	80.57	82.10	28.37	29.76	9.27	10.25	3.75	3.97
L. S. D. 0.05		3.54	3.05	1.32	1.25	2.10	2.02	3.36	3.25	2.11	2.01	1.34	1.12	1.02	1.01
Zinnia elegans plants															
400	Control	38.47	39.26	5.00	5.00	30.27	30.70	29.43	30.67	8.59	9.00	7.57	7.99	0.92	1.00
	0.5 %	40.30	42.37	8.00	8.33	32.27	33.65	30.90	31.09	10.67	11.00	8.60	8.87	1.17	1.25
	1.0%	51.53	53.26	9.00	9.67	36.37	38.58	38.50	39.67	10.90	11.21	9.09	9.58	1.38	1.51
	1.5 %	55.20	57.21	9.67	9.67	40.07	46.95	51.53	52.97	12.59	13.03	9.49	9.99	1.85	2.00
600	Control	41.67	41.05	5.00	5.33	33.40	33.90	32.67	33.07	9.71	10.25	7.70	7.95	1.24	1.45
	0.5 %	45.33	46.37	9.00	9.67	40.33	42.37	35.53	36.03	10.61	11.25	9.33	9.67	1.44	1.85
	1.0%	53.43	55.37	9.67	10.00	44.47	46.27	41.60	42.37	11.54	12.59	9.40	10.35	1.85	2.64
	1.5 %	60.53	63.95	10.33	10.67	49.37	51.36	61.53	62.06	14.56	15.97	10.98	11.24	2.07	2.40
800	Control	42.97	41.20	6.00	6.33	35.47	35.69	34.33	36.99	10.58	10.97	7.53	7.96	1.64	1.99
	0.5 %	47.37	48.66	10.33	10.67	42.47	43.70	41.47	43.03	11.47	12.25	9.57	9.97	1.96	2.06
	1.0%	54.50	55.36	10.67	10.67	45.60	46.35	44.30	48.60	15.19	16.36	10.60	10.96	2.06	2.57
	1.5 %	62.60	62.32	11.67	11.00	51.50	53.00	67.57	68.10	16.41	17.99	12.63	12.00	2.81	3.91
L.S.D. 0.05		3.12	2.95	1.65	1.47	2.21	2.54	2.95	2.84	1.24	1.14	1.97	1.38	0.79	0.89
Gomphrena globosa plants															
400	Control	31.50	31.67	15.00	15.33	14.60	15.69	25.43	27.67	6.75	6.54	4.35	3.53	0.92	0.90
	0.5 %	40.03	40.52	20.00	20.33	17.40	18.67	41.47	43.67	7.68	7.50	5.02	4.69	0.97	1.14
	1.0%	41.83	42.32	23.33	23.67	19.87	20.99	51.40	53.49	8.65	8.72	5.68	5.46	1.14	1.17
	1.5 %	44.57	46.02	25.67	25.69	20.70	21.33	53.47	54.67	8.94	8.80	6.25	6.21	1.17	1.20
600	Control	34.40	35.67	16.00	16.33	15.30	16.33	36.40	40.00	7.13	7.24	3.57	3.85	0.97	0.90
	0.5 %	40.43	41.67	20.33	21.67	18.43	19.00	50.37	54.34	8.18	8.25	5.37	5.16	1.01	1.13
	1.0%	43.47	44.26	25.33	26.00	21.53	21.67	54.27	58.37	8.95	8.94	6.54	5.99	1.13	1.27
	1.5 %	45.37	48.91	27.00	27.67	22.17	24.67	56.33	62.00	9.46	9.28	6.85	6.64	1.33	1.27
800	Control	37.20	37.67	19.33	19.67	16.80	18.00	41.37	44.67	7.26	7.56	4.64	3.93	1.03	1.13
	0.5 %	41.60	42.34	21.00	22.33	19.50	20.00	52.40	56.34	8.13	8.32	5.69	5.42	1.13	1.11
	1.0%	45.47	47.62	25.67	26.00	21.00	22.57	58.43	60.87	9.68	9.85	6.87	6.54	1.23	1.30
	1.5 %	48.17	50.67	26.67	29.47	22.50	25.49	59.47	65.34	9.97	10.24	7.23	6.87	1.44	1.52
L.S.D. 0.05		2.33	2.34	1.41	1.43	1.15	1.16	2.79	2.85	1.14	1.01	1.22	1.02	0.91	0.90

branches, shoots length and fresh and dry weight of shoot and roots, followed by the combination between such complete fertilizer rate with 600 m^3/fed of irrigation water but insignificant between them in plant height, number of shoots and fresh and dry weight of roots / plant.

Consequently, it could be suggested that the growth behaviour of *Tagetes erecta*, *Zinnia elegans* and *Gomphrena globosa* plants varied significantly according to irrigation water quantity and the used rates of complete fertilizer as fertigation. Similar results were reported regarding the effect of interaction between fertilizer and irrigation by Van Schaik and Struik (1997) on Aloe, El- Fawakhry (2004) on Cycas plants and Khalil, *et al.*(2004) on sweet potato.

2 -Chemical constituents:

a- Effect of irrigation water quantity:

Data presented in Table (6) showed that there was a consistent and significant increase in total chlorophyll and total carbohydrate in the tissues of *Tagetes erecta* , *Zinnia elegans* and *Gomphrena globosa* leaves by increasing soil moisture and /or increasing water supply. Whereas the maximum values in this respect were obtained by application of the highest level of irrigation water, i.e., (800 m^3/fed). On the contrary, the lowest values of all photosynthetic pigments were achieved via application of relatively lowest level of water supply (400 m^3/fed.). These results were hold true in the two investigated seasons.

It is known that the water quantity can ever be a directly limiting factor in chlorophylls content and is important in increasing the availability of nitrogen and other minerals and increasing its absorption by the plant so increasing total chlorophylls content in the leaves. The obtained results are in agreement with those reported by El-Fawakhry (2004) on cycas plants, Khattab *et al.* (2002) *Salvia splendens.*

It is quite clear from data in Table (6) that application of irrigation water at (800 m^3/fed.) being the most effective and favorable treatment, which recorded in most cases the maximum increment of N, P and K concentration in the leaves. On the contrary, increasing soil moisture stress and /or application of the lowest water quantity (400 m^3/fed.) being the inferior one on the content of N , P and K in the three plants. Similar findings were also reported by Khattab *et al.*(2002) on *Salvia splendens* plants and Cox (1995) on *Tagetes erecta* plants. The superiority of increasing water supply on the content of N, P and K elements in the leaves of *Tagetes erecta, Zinnia elegans* and

Table (6): Effect of irrigation water quantity on some chemical constituents of *Tagetes erecta*, *Zinnia elegans and Gomphrena globosa* plants during 2002 and 2003 seasons.

Treatments	Total Chlorophyll		Total carbohydrate %		N%		P%		K%	
Irrigation water quantity (m^3/fed.)	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Tagetes erecta plants										
400	1.87	1.95	23.67	25.16	2.075	2.123	0.108	0.109	2.925	3.214
600	2.05	2.14	24.51	26.36	2.188	2.435	0.115	0.118	3.101	2.994
800	2.28	2.32	26.25	28.37	2.383	2.458	0.119	0 121	2.998	3.159
L.S.D. 0.05	0.11	0.12	0.36	0.36	0.191	0.187	0.018	0.015	0.154	0.184
Zinnia elegans plants										
400	1.96	2.01	20.34	21.36	1.933	1.987	0.106	0.109	3.433	3.568
600	2.28	2.41	23.64	24.96	2.005	2.235	0.112	0.118	3.587	3.862
800	2.51	2.64	22.28	25.37	2.274	2.687	0.119	0.121	3.488	3.598
L.S.D. 0.05	0.15	0.16	0.33	0.34	0.148	0.174	0.012	0.005	0.125	0.162
Gomphrena globosa plants										
400	1.68	1.85	30.81	31.01	3.214	3.311	0.401	0.402	3.561	3.521
600	2.36	2.51	32.79	33.25	3.861	3.585	0.446	0.427	3.674	3.598
800	2.85	2.92	31.96	32.08	3.711	3.612	0.411	0.413	3.481	3.521
L.S.D. 0.05	0.17	0.16	0.98	1.00	0.150	0.162	0.020	0.011	0.114	0.121

Gomphrena globosa plants due to that increasing soil moisture content caused a marked effect on increasing the solubility of such elements in the soil which led to promote the absorbing efficiency of such elements by the plants.

b- Effect of fertilizer rates:

It is obvious from data recorded in Table (7) that the maximum values chlorophyll and carbohydrate were obtained with application of the highest fertilizer rate (1 and 1.5%). Adverse effect, however was recorded by fertigated of the lowest fertilizer rate of complete fertilizer (0.5%) and without fertilizer treatments was the inferior one.

In this connection, the promoting effect of complete fertilizer on increasing the photosynthetic pigments is probably due to the enhancing effect of the suitable fertigation, directly or indirectly on increasing the availability and absorption of the essential nutrient elements, specially nitrogen, iron and magnesium which are necessary for enzymes activation and formation of chloroplasts and chlorophyll as reported by John and David (2000). Moreover, the favorable effect of potassium on photosynthetic pigments as due to that potassium promotes assimilation rate of CO_2 and photosynthetic capacity (Haeder and Mengel 1974).

Data presented in Table (7) showed clearly that all used rates of fertigation resulted in different values of N, P and K elements content in the leaves of *Tagetes erecta*, *Zinnia elegans* and *Gomphrena globosa* plants. Maximum values by addition the rates of 1.5 and 0.1% through irrigation water compared without fertigation treatment. On the other hand, there were slight different values among all treatments which applied with fertilizer through drip irrigation (fertigation).

Application of fertilizers through irrigation system (fertigaion) reduced leaching of added fertilizer (Munikrishnap *et al.*2002). The obtained results are in accordance with (Khalil *et al.*2004) who showed that application of nitrogen and potassium fertilizers at the rate of 100 kg N + 140 kg K_2O/ fed. through irrigation water recorded the maximum values of growth rate and photosynthetic pigments, whereas, application of the balance rate of nitrogen and potassium at the level of (60 kg N + 60 kg K_2O / fed.) being the superior treatment regarding plant nutritional status (N, P, K content and their total uptake) on sweet potato plants.

Table (7): Effect of complete fertilization on some chemical constituents of *Tagetes erecta*, *Zinnia elegans* and *Gomphrena globosa* plants during 2002 and 2003 seasons.

Treatments	Total Chlorophyll content (mg/gm)		Total carbohydrate %		N%		P%		K%	
Fertilization	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Tagetes erecta plants										
Control	1.98	1.99	19.73	21.02	1.833	1.897	0.018	0.009	2.271	2.312
0.5%	2.33	2.51	22.85	24.02	2.388	2.124	0.112	0.119	2.633	2.698
1.0%	2.47	2.52	27.12	30.25	2.337	2.457	0.121	0.139	3.277	3.301
1.5%	2.82	2.86	29.54	32.26	2.603	2.801	0.137	0.141	3.851	3.951
L.S.D. 0.05	0.52	0.61	0.41	0.45	0.191	0.157	0.021	0.014	0.115	0.125
Zinnia elegans plants										
Control	1.86	1.75	17.45	18.69	1.553	1.869	0.008	0.009	2.844	2.994
0.5%	2.21	2.39	19.71	21.66	1.909	1.998	0.106	0.112	3.527	3.589
1.0%	2.39	2.42	24.47	26.85	2.356	2.658	0.137	0.148	3.777	3.894
1.5%	2.68	2.59	26.73	28.70	2.466	2.668	0.131	0.154	3.863	3.896
L.S.D. 0.05	0.50	0.60	0.95	0.99	0.114	0.112	0.016	0.014	0.121	0.138
Gomphrena globosa plants										
Control	1.47	1.50	27.11	27.90	2.521	2.964	0.365	0.345	3.004	2.684
0.5%	1.99	2.01	28.20	28.35	3.032	2.968	0.396	0.384	3.451	3.254
1.0%	2.48	2.65	35.91	36.05	3.516	3.499	0.405	0.395	3.612	3.546
1.5%	2.71	2.69	38.20	38.66	3.559	3.568	0.405	0.402	3.689	3.360
L.S.D. 0.05	0.73	0.84	1.13	1.15	0.154	0.132	0.012	0.054	0.213	0.325

c- Effect of interaction between irrigation water quantity and fertilizer rates:

Data in Table (8) generally showed that the highest level of irrigation water (800 m^3/fed) and application of the highest rate of fertigation (1 and 1.5 %) being the superior treatment on the content of total chlorophyll, as well as total carbohydrates in the two seasons. On the other hand, effect of the interaction between irrigation water supply at (400 m^3/fed.) and rate of 0.5% fertilizer recorded the minimum values of chlorophyll in both seasons.

The obtained results in Table (8) showed also that application 800 m^3/fed. of irrigation water combined with o.1 and 1.5% of fertilizer recorded the maximum increments in N, P and K content in the leaves of *Tagetes erecta, Zinnia elegans* and *Gomphrena globosa* plants, while, the lowest level of water supply combined with low rate of fertilizer 0.5 % gave the lowest values in this respect.

3- Flowering characters:

a- Effect of irrigation water quantity:

Data presented in Table (9) indicated that the different quantities of irrigation water exerted a marked and significant effect on flowering characters of *Tagetes erecta, Zinnia elegans* and *Gomphrena globosa* plants. Whereas, application of irrigation water at a level of 800 m^3/fed. being the most effective and favorable treatment as well as recorded the maximum values in this respect. On the contrary, the lowest values of flowering characters were obvious with application of lowest level of irrigation water and /or increasing soil moisture water stress. The superiority effect of irrigation water at the level of 800 m^3/fed. during the growing seasons on *Tagetes erecta, Zinnia elegans* and *Gomphrena globosa* plants is directly owing to the increase in plant growth rate and its dry matter content, as well as, plant minerals uptake so, the flowering can be considered as the final resultant of all physiological and metabolic processes in the plant.

Furthermore water use efficiency, leading to increase the availability and absorption of nutrient elements necessary for flowering precursors of a class of compounds, which ultimately forms amino acids and hormones leading to an earlier flowering , gave many lateral branches and number of flowers /plant (Mostafa and Asker 1997). Also, increase the flower duration, for enough amount of water need for keeping flower cells in turgidity status (Shonks and Gowin 1985). Also, increasing in flower dry weight may be due to the

Table (8): Effect of irrigation water quantity on some chemical constituents of *Tagetes erecta, Zinnia elegans and Gomphrena globosa* plants during 2002 and 2003 seasons.

Treatments		Total Chlorophyll content (mg/gm)		Total carbohydrate %		N%		P%		K%	
Irrigation water quantity (m^3/fed.)	fertilization	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Tagetes erecta plants											
400	Control	1.65	1.81	18.44	21.36	1.711	1.841	0.007	0.008	2.241	2.286
	0.5%	1.84	1.92	21.42	23.69	2.001	2.201	0.113	0.114	2.511	2.633
	1.0%	2.05	2.13	28.21	27.85	2.381	2.498	0.124	0.115	3.161	3.189
	1.5%	2.14	2.21	30.58	29.37	2.401	2.523	0.121	0.139	3.491	3.399
600	Control	1.87	1.96	19.34	20.26	1.831	1.951	0.009	0.008	2.321	2.456
	0.5%	1.91	2.00	22.60	24.37	2.091	2.154	0.111	0.115	2.721	2.841
	1.0%	2.24	2.35	26.56	28.37	2.631	2.412	0.123	0.127	3.411	3.465
	1.5%	2.39	2.42	29.54	33.58	2.602	2.665	0.127	0.141	3.551	3.587
800	Control	1.98	2.03	21.40	22.24	1.961	2.011	0.009	0.011	2.253	2.286
	0.5%	2.36	2.39	24.60	24.33	2.163	2.741	0.015	0.038	2.671	2.768
	1.0%	2.57	2.61	26.60	29.99	2.601	2.784	0.122	0.148	3.261	3.274
	1.5%	2.64	2.70	28.50	30.58	2.612	2.863	0.133	0.153	3.311	3.491
L. S. D 0.05		0.72	0.86	2.35	2.06	0.181	N. s.	N.S.	N.S.	N.S.	N.S.
Zinnia elegans plants											
400	Control	1.69	1.85	16.31	18.37	1.401	1.689	0.008	0.009	2.751	2.798
	0.5%	2.11	2.25	17.34	18.66	1.807	1.987	0.009	0.011	3.471	3.684
	1.0%	2.24	2.28	22.66	23.65	2.191	2.352	0.121	0.125	3.661	3.894
	1.5%	2.29	2.31	24.37	25.33	2.337	2.456	0.127	0.128	3.850	3.963
600	Control	1.99	2.00	18.43	19.99	1.451	1.698	0.009	0.101	2.911	3.001
	0.5%	2.36	2.39	19.34	21.55	1.841	1.993	0.101	0.103	3.601	3.465
	1.0%	2.51	2.49	24.37	26.86	2.321	2.652	0.131	0.138	3.911	3.894
	1.5%	2.59	2.60	27.01	30.00	2.411	2.684	0.131	0.135	3.931	3.899
800	Control	2.20	2.24	18.99	20.96	1.811	1.968	0.009	0.011	2.873	2.896
	0.5%	2.25	2.31	21.34	23.30	2.081	2.352	0.123	0.128	3.511	3.682
	1.0%	2.62	2.66	26.36	28.66	2.557	2.667	0.130	0.134	3.761	3.789
	1.5%	2.68	2.69	28.70	31.26	2.651	2.901	0.137	0.141	3.811	3.897
L. S. D 0.05		0.83	0.91	1.86	1.96	N. s.	N. s.	N. s.	N. s.	N. s.	N. s.
Gomphrena globosa plants											
400	Control	1.52	1.64	25.02	25.69	2.324	2.302	0.315	0.314	2.145	2.151
	0.5%	1.72	1.71	26.33	27.01	2.475	2.542	0.342	0.354	3.113	3.101
	1.0%	1.79	1.85	35.58	35.87	2.601	2.661	0.365	0.354	3.214	3.204
	1.5%	1.83	1.89	36.54	36.59	3.025	2.976	0.394	0.384	3.294	3.215
600	Control	1.64	1.69	25.54	25.88	2.486	2.412	0.324	0.309	2.214	2.301
	0.5%	1.86	1.92	27.37	27.79	2.694	2.652	0.351	0.361	3.154	3.201
	1.0%	1.97	2.01	35.69	36.02	3.011	2.998	0.374	0.325	3.301	3.294
	1.5%	2.15	2.34	38.54	38.87	3.164	3.145	0.414	0.401	3.543	3.453
800	Control	1.94	2.01	27.22	27.70	2.794	2.654	0.346	0.339	2.231	2.310
	0.5%	2.26	2.34	29.48	30.03	2.812	2.811	0.358	0.336	3.171	3.162
	1.0%	2.57	2.62	37.26	37.47	3.451	3.351	0.375	0.358	3.321	3.325
	1.5%	2.73	2.87	39.56	38.69	3.432	3.441	0.446	0.424	3.571	3.540
L. S. D 0.05		1.01	1.06	1.95	2.00	N. s.	N. s.	N. s.	N. s.	N. s.	N. s.

Table (3): Effect of irrigation water quantity on some growth characters of *Tagetes erecta*, *Zinnia elegans* and *Gomphren globosa* plants during 2002 and 2003 seasons

Treatments Irrigation water quantity (m^3/fed.)	Plant height (cm)		No. of shoots /plant		Shoot length (cm)		Fresh weight /plant (g)		Dry weight /plant (g)		Fresh weight of roots /plant (g)		Dry weight of roots /plant (g)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Tagetes erecta plants														
400	43.72	47.57	6.50	6.98	18.11	19.95	49.74	52.13	13.40	15.06	5.28	5.69	2.53	2.65
600	45.88	47.95	6.96	7.21	20.76	24.37	57.30	59.69	16.98	18.26	6.22	6.58	2.90	3.01
800	49.78	52.35	7.42	8.53	25.30	28.35	66.63	67.13	20.69	23.99	7.73	7.80	2.94	3.12
L.S.D. 0.05	1.04	1.12	0.62	0.65	0.59	0.60	3.22	3.56	1.02	1.15	0.60	0.60	0.38	0.39
Zinnia elegans plants														
400	47.38	48.99	6.67	6.75	35.92	37.99	37.59	39.06	10.69	11.90	8.68	9.00	1.33	1.59
600	50.74	51.26	7.50	7.67	41.89	44.26	43.41	45.26	11.60	12.00	9.35	10.22	1.65	1.86
800	52.87	54.36	8.75	9.00	43.76	46.40	47.92	48.97	13.41	14.89	10.08	12.00	2.12	2.90
L.S.D. 0.05	2.30	2.42	0.80	0.81	1.29	1.37	2.53	2.69	0.73	0.76	0.47	0.63	0.05	0.07
Gomphrena globosa plants														
400	39.48	41.00	21.00	21.67	24.37	23.70	32.45	34.90	8.33	9.43	4.51	5.02	1.06	1.04
600	40.92	42.13	21.75	22.35	28.69	26.35	39.55	40.35	9.19	10.31	5.42	5.69	1.35	1.47
800	43.11	44.99	23.67	24.67	31.25	32.57	41.35	43.52	10.66	11.36	6.03	5.97	1.44	1.52
L.S.D. 0.05	1.10	1.11	0.71	0.72	1.26	1.42	1.43	1.37	0.94	0.99	0.75	0.57	0.06	0.09

studied growth characters of *Tagetes erecta*, *Zinnia elegans* and *Gomphrena globosa* plants in both seasons. This findings may be due to that water stress causes losses in tissues water which led to reduce the turger pressure in the cells, thereby inhibition enlargement and division of the cells. In this regard Hsiao and Acevedo (1974) and Martin and Ruiz – Torres (1992) came to similar conclusion. The obtained results are in agreement with these reported by Khattab *et al.* (2002) on *Salvia splendens* and El- Fawakhry (2004) on Cycas plants.

b- Effect of complete fertilizer rate:

The obtained results in Table (4) indicated that there was a constant and progressive increase in plant height number and shoot length per plant as well as, the fresh and dry weight of shoots and roots by increasing the application of complete fertilizer up to the highest rate, i.e. 0.1 and 1.5% through irrigation water (fertigation), but without showing significant difference between them. Similar results were obtained by El-Tarawy and Menesi (1989) on *Tagetes erecta* and *Zinnia elegans* plants. Kandeel *et al.*, (2002) on *Chrysanthemum parthenium* plants and Munikrishnap *et al.* (2002) on tuberose.

From the forgoing results, it could be concluded that the promoting effect of using complete fertilizer through irrigation water on the growth rate of *Tagetes erecta*, *Zinnia elegans* and *Gomphrena globosa* plants might due to the following reasons. Fertilizers availability is fitted to nutritional need of the plant during its growth cycle, fertilizer elements already pass to the roots faster than uniformity of fertilizers distribution. Moreover, as for positive effect of both macro elements and microelements in fertigation, more nutrient availability especially near the root zone might have increased the transport of metabolites to support the growth (Banker and Mukhopadyay (1990), Yadav *et al.*(1986). Similarly K might have influenced the cell division and thus cambial growth leading to more number of leaves (Parthibam *et al.* 1991). Once more number of leaves are formed, availability of photo assimilates increases to affect plant growth. Hence, more plant height and tiller number of tuberose were observed in fertigation with NPK supplemented with 0.1% or 0.5% Zn. (Munikrishnap *et al.* 2002) and (Chaturvedi *et al.* 1986) on gladiolus.

c- Effect of interaction between irrigation water quantity and fertilizer rates:

The obtained results in Table (5) showed that the irrigation water at 800 m^3/fed in combined with 1.5% of complete fertilizer as a fertigation had a marked high values in the plant height, number of

Table (4): Effect of complete fertilization on some growth characters of *Tagetes erecta, Zinnia elegans* and *Gomphrena globosa* plants during 2002 and 2003 seasons.

Treatments Fertilization	Plant height (cm)		No. of shoots /plant		Shoot length (cm)		Fresh weight /plant (g)		Dry weight /plant (g)		Fresh weight of roots /plant (g)		Dry weight of roots /plant (g)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Tagetes erecta plants														
Control	39.57	42.01	4.67	4.87	16.89	17.96	43.51	44.30	10.93	11.24	5.13	5.63	1.94	2.01
0.5%	45.07	46.99	6.06	6.99	20.34	21.36	53.37	55.37	16.87	18.32	6.00	6.98	2.76	2.95
1.0%	48.94	51.70	8.44	8.27	24.54	25.65	71.12	73.02	22.66	23.35	6.78	7.85	3.03	3.24
1.5%	52.88	55.32	8.67	8.87	25.79	26.69	74.57	75.33	24.62	25.04	7.63	8.63	3.44	3.62
L.S.D. 0.05	4.20	4.46	0.72	0.82	0.22	0.42	3.71	3.90	2.18	2.30	0.69	0.86	0.44	0.48
Zinnia elegans plants														
Control	40.37	41.26	5.67	6.00	33.04	34.06	35.58	36.70	9.63	9.98	7.60	8.03	1.27	1.30
0.5%	45.67	47.69	7.00	7.33	38.36	39.99	41.97	38.97	11.52	11.57	9.17	10.25	1.52	1.75
1.0%	56.16	57.95	8.56	9.00	46.14	46.60	56.47	58.70	13.54	13.97	10.69	11.17	2.13	2.17
1.5%	59.44	60.10	9.33	9.67	48.64	51.26	60.21	63.25	15.52	15.99	11.04	12.14	2.78	2.65
L.S.D. 0.05	3.66	3.86	0.93	0.95	3.49	3.54	5.23	5.96	1.49	1.50	0.96	0.99	0.06	0.09
Gomphrena globosa plants														
Control	34.37	35.03	16.22	16.33	16.26	15.96	28.46	27.95	7.37	6.35	4.69	4.33	1.03	1.00
0.5%	40.69	42.33	20.44	21.00	18.67	19.87	36.58	37.06	9.25	9.62	5.37	5.47	1.21	1.32
1.0%	43.59	45.67	24.78	25.01	20.34	21.57	39.27	40.36	9.95	10.13	6.13	6.35	1.35	1.34
1.5%	46.03	49.57	27.11	27.99	21.37	21.65	40.37	40.62	10.35	10.54	6.36	6.45	1.45	1.37
L.S.D. 0.05	1.27	1.29	1.98	1.99	1.63	1.68	3.66	4.02	0.54	0.52	0.42	0.47	0.05	0.05

Table (11): Effect of irrigation water quantity on some flowering characters of *Tagetes erecta*, *Zinnia elegans* and *Gomphrena globosa* plants during 2002 and 2003 seasons.

Treatments		Days to first flower open		Flowering period (days)		Inflorescence diameter (cm)		Shoots number/plant		No. of flowers / plant		Vase-life (days)	
Irrigation water quantity (m^3/fed.)	fertilization	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Tagetes erecta plants													
400	Control	31.5	32.4	39.7	41.3	2.87	3.06	4.33	4.67	5.38	5.00	5.3	6.7
	0.5%	33.6	33.1	46.7	50.3	3.13	3.68	8.00	8.33	8.38	9.12	5.6	6.0
	1.0%	35.4	34.8	50.0	51.4	3.53	4.02	8.33	8.67	8.86	9.66	6.2	6.7
	1.5%	36.1	35.9	53.7	55.7	3.93	4.11	11.00	11.33	10.93	11.89	6.9	7.0
600	Control	34.3	33.8	40.0	45.4	3.00	3.35	5.00	6.03	5.48	6.86	5.8	6.0
	0.5%	35.6	35.2	50.7	59.0	3.40	3.84	8.01	8.67	8.38	9.33	6.4	6.7
	1.0%	37.8	37.1	54.0	61.6	3.90	4.09	10.00	10.33	11.54	11.37	6.8	6.9
	1.5%	38.9	37.8	63.0	65.3	4.20	4.58	12.01	12.67	13.45	13.68	7.4	8.0
800	Control	36.8	34.7	46.3	48.4	3.93	4.01	6.33	7.00	7.36	7.25	4.9	5.1
	0.5%	38.4	37.5	54.7	60.6	3.83	4.35	9.67	10.34	10.38	10.66	7.3	7.9
	1.0%	40.1	40.6	58.7	63.8	4.13	4.69	11.67	11.67	12.38	12.38	8.2	8.7
	1.5%	42.8	41.9	71.3	76.3	4.52	4.96	12.67	13.33	14.13	14.33	8.6	9.0
L. S. D	0.05	1.4	1.6	2.0	2.0	0.36	0.25	1.15	1.10	2.69	2.86	0.9	1.0
Zinnia elegans plants													
400	Control	28.4	27.8	36.0	36.3	3.80	3.96	5.00	5.00	5.33	5.66	5.0	5.3
	0.5%	29.6	28.8	42.0	42.3	4.00	4.33	6.00	6.00	6.33	6.68	5.5	5.7
	1.0%	30.2	29.6	44.0	44.7	4.97	5.00	7.00	7.33	7.36	7.66	6.3	6.3
	1.5%	30.8	30.2	47.0	47.3	5.30	5.33	8.00	8.33	8.68	9.00	6.6	6.7
600	Control	30.4	29.7	38.3	39.7	4.00	4.00	6.00	6.00	6.39	6.33	5.5	5.7
	0.5%	31.2	30.9	47.0	47.7	4.10	4.33	7.00	7.33	7.33	8.00	6.0	6.0
	1.0%	33.6	33.1	48.0	49.0	5.00	5.33	9.33	9.67	10.33	10.33	6.7	7.0
	1.5%	34.5	34.0	53.7	54.3	5.40	5.67	10.00	10.67	10.68	11.00	7.3	7.3
800	Control	31.2	30.7	45.0	45.3	4.20	4.33	6.33	6.33	6.68	7.00	5.7	5.7
	0.5%	32.9	32.3	51.0	52.3	4.80	4.96	8.33	8.67	8.67	9.33	6.6	7.0
	1.0%	34.9	34.3	57.0	57.3	5.01	5.33	10.33	10.67	10.68	11.68	7.4	7.7
	1.5%	35.8	35.4	58.3	56.7	5.50	5.67	11.33	11.67	12.33	12.66	8.6	8.7
L. S. D	0.05	1.4	1.5	1.5	1.6	0.29	0.29	1.02	1.08	2.14	2.37	0.8	0.8
Gomphrena globosa plants													
400	Control	21.9	20.0	67.0	68.3	2.20	2.20	19.33	20.00	21.13	22.13	8.0	8.2
	0.5%	25.6	25.1	75.0	77.3	2.30	2.30	20.00	21.34	23.68	24.00	8.4	8.1
	1.0%	27.3	26.7	84.0	86.0	2.40	2.40	22.67	25.37	24.68	26.33	9.3	8.3
	1.5%	28.9	28.2	86.0	88.3	2.60	2.61	26.33	27.34	28.68	29.13	9.9	9.0
600	Control	23.6	23.1	73.0	76.7	2.33	2.34	20.00	21.33	22.48	23.66	8.1	8.5
	0.5%	26.5	25.9	84.0	85.3	2.30	2.33	23.00	23.67	25.36	25.66	8.3	7.7
	1.0%	28.6	28.4	88.0	89.0	2.43	2.44	24.00	24.67	26.00	26.68	9.2	9.0
	1.5%	29.1	28.7	90.3	91.0	2.70	2.73	28.00	28.33	29.33	30.00	10.1	10.0
800	Control	24.6	24.2	78.0	80.0	2.40	2.40	23.33	23.67	25.86	26.13	7.3	8.0
	0.5%	26.9	26.4	89.0	88.3	2.53	2.60	25.33	25.67	27.33	28.00	9.0	9.1
	1.0%	29.0	28.6	93.0	94.7	2.60	2.63	27.33	28.00	29.76	30.33	10.6	10.0
	1.5%	30.4	29.8	98.0	95.7	2.90	2.93	30.33	29.67	31.66	32.68	11.5	10.0
L. S. D	0.05	2.3	2.3	1.5	1.5	0.29	0.30	1.02	1.05	3.45	4.15	0.9	0.8

REFERENCES

Banker, G. J. and A. Mukhopadyay (1990). Effect of NPK on growth and flowering of tuberose cv. Double. Indian J. Hort. (47): 120-126.

Barham, I. H., N. E. Mousa, N. E. El-Keltawi and A. A. Tafik (1986). Growth and flowering of *Viola odorata* L. as influenced by soil moisture and urea spray. Assiut. J. Agric. Sci., 14 (4): 3-12.

Black, A. (1965). Methods of soil analysis Am. Soc. Agron., Madison, Wisconsin, U. S. A.

Chaturvedi, O. P., I. N. Shukia and A. R. Singh (1986). Effect of Agromen on growth and flowering of gladiolus. Progr. Hort. (18): 194-196.

Cox, D. A. (1995). Palletized sewage sludge as a fertilizer for containerized plants: plant growth and nitrogen leaching losses. J. P. Nutrit., 18: 2783-2795.

Devit, D., R. Morris and D. Bowman (1991). Response of tall fescue to composted sewage sludge used as a soil amendment. J. of Plant Nutrition, 13: 1115-1139.

El-Fawakhry, F. M. (2004). Effect of different schedules of drip irrigation and complete liquid fertilizer rates on growth of Cycas plants (*Cycas revolute*). J. Agric. Sci. Mansoura Univ., 29 (12): 7273-7285.

El-Mahrouk, E. M., F. A. Menesi and B. A. Abdel-Maksoud (1992). Response of *Helipterum roseum*, Benth and *Delphinum ajacus* L. to NPK fertilization. 1-Vegetative growth and flowering. J. Agric. Res. Tanta Univ., 18(4): 703 – 714.

El-Tarawy, M. A. and F. A. Menesi (1989). Response of both *Tagetes erecta* L. and *Zinnia elegans* J. plants to foliar spray with urea and some commercial fertilizers. J. Agric. Res. Tanta. Univ., 15 (2): 330-346.

Haeder, H. E. and K. Mengel (1974). Effect of nitrogen on CO_2 assimilation and grain filling of wheat during the reproductive stage P. 135-145 Proc. 7th intern. Collog. on Plant Analysis and Fertilizer Problems, Hannover.

Hsioa, T. C. and E. Acevedo (1974). Plant response to water delicate, water use efficiency and drought resistance. Agric. Metrology 14: 59-84.

Jackson, M. L. (1970). Soil Chemical Analysis Prentice Hall of India, Private Limited; New Delhi, P. 115.

John, S. H. and A. W. David (2000). Soil conditioners North Central Regional Extension Publication 295.

Kandeel, Y. M., E. S. Nofal, M. M. Khalafalla and T. E. Eissa (2002). Effect of nitrogen fertilization on vegetative growth, flowering and chemical composition of *Chrysanthemum parthenium* (L.) Bernha. Inter. Proc Conf. Hort. Sci., 10 –12 Sept., Kafr El-Sheikh, Tanta Univ. Egypt. p. 1359 – 1378.

Khalil, M. A., E. A. El-Ghamriny, and I. I. Ayoub (2004). Effect of irrigation water quantity and application of nitrogen and potassium as fertigation method on sweet potato plants under sandy soil conditions .Zagazig J. Agric. Res., 31 (3): 2139-2168.

Khattab, M., Ola El-Shennawy; M. Moustafa and N. Gomaa (2002). Effect of some soil conditioners and irrigation rates on the growth and flowering of *Salvia splendens* plants. Alex. J. Agric. Res. 47 (2): 163-172.

Martin, B. and N. A. Ruiz-Torres (1992). Effect of water-deficit stress on photosynthesis, its components and component limitations, and on water use efficiency in wheat (*Triticum sativum L.)* Plant Physiology. 100: 733-739.

Mostafa, M. M. and F. A. Asker (1997). Effect of soil conditioners on the growth of *Dianthus barbatus* and *Senecio cruentus* plants. J. Agric. Sci. Mansoura Univ., 22: 1155-1167.

Munikrishnap, P. M. , M. C. Gowda, A. A. Farooqi and Y. A. Nanja Redddy (2002). Fertigation studies in tuberose cv. Single. Indian J. Hort., 59 (1) : 111-112.

Olsen, S. R. and L. E. Sommers (1982). Phosphorous. In : Page A. L. R . H. Miller, and D. R. Keeny (Eds.) Agron. Madison W. I. U. S. A. pp. 430-430.

Parthiban, S., A. Khader and S. Thambura (1991). Effect of N, P and K on growth and development of tuberose. Indian J. Hort. 40: 260-65.

Piper, C. S. (1950). Soil and Plant Analysis. Inter science Pub., Inc., New York.

Rubinder, k. and R. Kumar (1998). Effect of N, P and plant spacing on growth and flowering of pansy (*Viola tricolor* L.) Indian J. Hort., 55 (4): 337-339.

Sendecor, G. W. and W. C. Cochran (1980). Statistical Methods. 6th ed., Lowa Univ. Press. Ames. Lowa, USA, p. 237.

Shonks, J. and F. Gowin (1985). Using compost in the root medium for roses. Bio Cycle 25:29-31.

Smith, F., M. A. Gilles, D. K. Hamillton and P. A. Geed (1958). Colorimetric method for determination of sugars and related substances . Ann. Chem., 28: 350.

Sterling, D. (1983). Drip irrigation in irrigation (ed) Heinz., H. W. irrigation Association, Silver Spring Maryland.

Szabo, L. and E. Papp (1975). The medicinal uses of *Tagetes* species. Botanical, Chemical, Pharmacological and Agronomic Gyogyzerestec. 19 (8): 281-285. (Hort. Abst., 46 (11): 10678).

Van Schaik, A. h. and P. C. Struik, (1997). Effect of irrigation and N on the vegetative growth of *Aloe barbadensis*. Trop. Agric. (Trinidad)Vol. 74 (2): 104 -109.

Yadav, L. P., T. K. Bose and R. G. Maiti (1986). Response of tuberose to nitrogen and phosphorus fertilization. Progr. Hort. 17: 83-86.

الملخص العربى

تأثير كمية ماء الري و إضافة السماد الكامل عن طريق ماء الري على بعض نباتات الزينة تحت ظروف العريش

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أجريت تجربتان حقليتان في المزرعة التجريبية بكلية العلوم الزراعية البيئية بالعريش – جامعة قناة السويس خلال فصل الصيف لموسمي ٢٠٠٢ و ٢٠٠٣ بهدف دراسة تأثير كميات مختلفة من ماء الري و التسميد الكامل من خلال ماء الري علي معدل النمو الخضري والزهري و حالة العناصر الغذائية في نباتات القطيفة و الزينيا و المدنة.

ولقد أوضحت النتائج المتحصل عليها في اغلب الحالات أن إضافة ماء الري بمعدل (٨٠٠م٣ / فدان) كان أكثر المعاملات تأثيرا و فاعلية علي زيادة معدل النمو الخضري و الصفات الزهرية لكل من النبات و وحدة المساحة وكذلك محتوي النباتات من العناصر المعدنية ، يتبعها في ذلك كمية ماء الري(٦٠٠م٣)، بينما كمية ماء لري المنخفضة(٤٠٠م٣/للفدان) أعطت اقل القيم.

ومن ناحية أخري، أدي استخدام التسميد الكامل من سماد السنجرال بمعدل ١- ١,٥ % من خلال ماء الري إلي تسجيل اعلي القيم لمعدل النمو الخضري والزهري و لكن بدون فروق معنوية بينهما في معظم الحالات. و قد أعطي التسميد ١% من السماد الكامل أفضل القيم للمحتوي الكلي من الكربوهيدرات و النتروجين و الفوسفور و البوتاسيوم بينما أعطي التركيز المنخفض٠,٥ % اقل القيم في هذا الشأن.

وبالنسبة لتأثير التفاعل بين عاملي الدراسة ، فقد أوضحت النتائج أنة في اغلب الأحيان لم تعكس تأثير معنوي لأغلب الصفات التي تم دراستها باستثناء بعض الصفات التي سجلت تأثيرا معنويا و لكنها كانت متباينة في الموسمين.