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GROWTH AND FLOWERING OF *CHRYSANTHEMUM Morifolium* PLANTS:
I. EFFECT OF GROWING MEDIA AND AMMONIUM SULPHATE ON *Chrysanthemum morifolium* CV. SUPER YELLOW.

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ABSTRACT

A pot experiment was executed during 2000 and 2001 consecutive seasons to explore the response of *Chrysanthemum morifolium* Ramat cv. Super Yellow plants grown in 4 different growing media (sand, sand + cotton seed hulls (C.S.H.), sand + hyacinth compost (HCN), or loamy soil), to 4 ammonium sulphate fertilization rates (0, 4, 8 or 16 g/25 cm pot).

Obtained results indicated that growing *Chrysanthemum* plants in sandy soil amended with cotton seed hulls (CSH) or hyacinth plants compost (HCN), as well as, loamy soil caused considerable increase in vegetative growth characters, flowering parameters, photosynthetic pigments and herb % of N, P an K, in comparison with those obtained by sandy soil-grown plants. The results of sand + CSH or sand + HCN were, nearly, equal to those of loamy soil. However, loamy soil delayed flowering date in comparison with that of sandy soil.

In relation to ammonium sulphate, the gradual increase in its rate caused gradual improve in all vegetative growth, flowering production and chemical composition, but the high rate of ammonium sulphate delayed flowering date of *Chrysanthemum* plants.

INTRODUCTION

Chrysanthemum morifolium, plant, (Fam. Asteraceae) is of great importance in the ornamental plants market. It is one of the highly desirable flowering plants used in flower beds, for cut flowers and as pot plant. The variation in flowers feature, size, shape and colour, as well as, the long vase life may explain the increasing demand on such plant.

Many workers studied the influence of different growing media types on various plant species, and reported that the addition of some composted organic materials such as cotton seed hulls (Abdou, 1987); hyacinth plants (El-Sirafy *et al.*, 1989), or akalona (Badran *et al.*, 1993) to soils of different texture makes the soil, and the sandy one in particular, capable of holding more water available for plant growth and enhances its physical, chemical and microbiological properties. By sequence, an appreciable improve should be occurred on vegetative growth, accompanied with an enhancement of flowering aspects and an increase in the uptake of different nutrients (Morsy *et al.*, 1982 on maize, Abdalla *et al.*, 1984 on different crops; Abdou, 1987 on *Khaya senegalensis* seedlings; El-Sirafy *et al.*, 1989 on pepper; Al-Badawy *et al.*, 1989 on *Chrysanthemum morifolium* and Badran *et al.*, 1993 on *Achillea millefolium*). Moreover, many trials were conducted on the improvement of the physio-chemical properties of the soils by the addition of

boudorite, town refuse, dried sludge and cereal straws (Abd-Elmalik *et al.*, 1970). Furthermore, Gohar *et al.*, (1978) concluded that the organic materials such as rice straw and cotton seed hulls increased the actinomycetes, fungi, azotobacter and cellulose decomposers.

Concerning the influence of nitrogen fertilization many investigators studied its effect on different herbaceous and ornamental plants. Abd-Alazeem (1993) on *Tagetes minuata*, Adham (1997) on *Rosa polyantha*, El-Mahrouk *et al.* (1999) on *Jasminum grandiflorum* and Badran *et al.* (2001) on *Tropaeolum majus* found that nitrogen fertilization at various rates enhanced different vegetative growth characters, flowering parameters and chemical constituents of such plants. Similar results were obtained on *Calendula officinalis* (Abdalla *et al.*, 1991 and Abdou *et al.*, 2003); *Chrysanthemum monifolium* (Attia and Ahmed, 1997 and Khattak *et al.*, 1999) and *Borago officinalis* (Refaat *et al.*, 2000).

MATERIALS AND METHODS

This investigation was conducted in the nursery of Fac. of Agric., Minia Univ. during the two successive seasons of 2000 and 2001 to study the influence of four growing media and four ammonium sulphate rates on *Chrysanthemum monifolium*, Ramat cv. Super Yellow.

Uniform 10-cm long cuttings were planted, individually, in 10-cm clay pots on March 1st 2000 and 2001. On June 1st the seedlings were transplanted to 25-cm clay pots filled with 5 kg of different growing media, *namely, sand; sand + cotton seed hulls (CSH) compost (1:1 v/v); sand +* hyacinth (HCN) plants compost (1:1 v/v) or loam. Physical and chemical properties of sand and loamy soils are shown in Table (A), while those of activated cotton seed hulls (CSH) and hyacinth compost (HCN) are shown in Table (B).

The experiment was arranged in split plot design with three replications and five plants in each replicate. The four growing media were the main plots and the four ammonium sulphate (20.6% N) rates, 0, 4, 8 or 16 g/pot were the sub plots. Two weeks after transplanting, all plants including control ones were pinched out. Each one of the ammonium sulphate rates was splitted to 4 equal doses and added, at 2-week intervals, starting one week after pinching. Moreover, all plants, including control ones, received 3 g/pot calcium superphosphate (15.5 % P_2O_5) before planting and 0.5 g/pot potassium sulphate (48.5% K_2O) one week after pinching. All other agricultural practices were performed as usual.

The following data were recorded: plant height, stem diameter, branch number, herb fresh and dry weights, flowering date (number of days from transplanting till flowering), flower diameter, number of flowers/plant, fresh weight /plant. Moreover, chemical analysis was carried out to determine N, P and K % in the herb according to A.O.A.C. (1980), and the contents of chlorophyll a and b and carotenoids were estimated in the leaves before flowering stage according to Fadl and Seri-Eldeen (1978). Obtained data were statistically analyzed using ANOVA test method as described by Little and Hills (1978).

Table (A): Physical and chemical properties of sand and loamy soils:

Property	Sandy soil	Loamy soil
Sand %	83.43	6.15
Silt %	12.46	40.72
Clay %	4.11	53.13
$CaCO_3$ %	10.05	1.55
Total N %	0.02	0.14
Exch. K mg/100 g	1.81	2.30
pH 1: 2.5	8.14	8.11
O.M. %	0.30	1.71
Carbon %	0.17	0.99
C/N ratio	15.8	7.58

Table (B): Physical and chemical properties of cotton seed hulls (CSH) and hyacinth compost (HCN).

Property	CSH	HCN
Moisture %	6.2	7.2
W.H.C. %	318.0	317.0
pH 1: 2.5	6.85	6.91
Total N %	2.61	3.50
O. M. %	60.01	59.12
Carbon %	34.84	36.91
C/N ratio	13.35	10.56

RESULTS AND DISCUSSION

Vegetative Growth Characters:

Obtained data in Tables (1 and 2) reveal that the addition of cotton seed hulls (CSH) or hyacinth plants compost (HCN) to the sandy soil caused considerable improvement in different vegetative growth traits, in both seasons, in comparison with those of plants grown on sandy soil. The differences between such two amended soils and the sandy one were significant for plant height; stem diameter and herb dry weight/plant in both seasons. Moreover, such two amended soil types were almost as effective as the superior loamy soil in increasing all vegetative growth characters as clearly shown in Tables (1 and 2).

The role of amended sandy soil in augmenting different vegetative growth characters of various herbaceous and ornamental plant species was reported by Abd-Elmalik *et al.* (1970), Gohar *et al.* (1978), Morsy *et al.* (1982), Aodalla *et al.* (1984), Abdou (1987), El-Sirafy *et al.* (1989), Al-Badawy *et al.* (1989) and Badran *et al.* (1993). The marked increase in different vegetative growth characters of plants grown in amended sandy soil may be due to the soil microorganisms which convert organic nitrogen to ammonia and nitrate, and to the low E.C. and high F.C. which supply available water in adequate quantities for cell turgidity and enlargement led to enhance plant height, stem diameter, branching and, by sequence, herb fresh and dry weights (Mastalerz, 1977). Moreover, Yashie and Watanbe (1966) reported

that the presence of organic materials in potting medium increased granulation, pore space and water holding capacity. Furthermore, the favourable effects of potting media (CSH and HCN) on vegetative growth characters may be due to the initial presence of high contents of N, P and K *in these media and containing raw organic matter* (composting cotton seed hulls and hyacinth plants) which provide the desired structural, water holding capacity and drainage properties.

Table (1): Effect of growing media and ammonium sulphate on vegetative growth of *Chrysanthemum morifolium* cv. Super Yellow during 2000 and 2001 seasons.

Growing media A	First season					Second season				
	Ammonium sulphate g/pot B					Ammonium sulphate g/pot B				
	0	4	8	16	Mean	0	4	8	16	Mean
	Plant height (cm)									
Sand	55.7	58.8	61.9	64.6	60.3	60.3	62.6	65.7	68.3	64.2
Sand +CSH	60.8	63.7	66.8	68.4	64.9	65.7	68.2	70.6	72.9	69.4
Sand +HCN	61.3	63.3	66.6	69.7	65.2	66.4	68.6	71.5	74.7	70.3
Loam	62.2	65.0	68.1	70.5	66.5	68.1	72.2	74.2	76.6	72.8
Mean	60.0	62.7	65.9	68.3		65.1	67.9	70.5	73.1	
L.S.D. 5%	A: 4.2	B: 3.8		AB: 7.6		A: 5.0	B: 4.4		AB: 8.8	
	Stem diameter (cm)									
Sand	4.12	4.28	4.46	4.58	4.36	4.32	4.57	4.81	4.96	4.67
Sand +CSH	4.42	4.52	4.74	4.85	4.63	4.47	4.90	5.20	5.36	5.06
Sand +HCN	4.47	4.61	4.85	4.92	4.71	4.82	5.08	5.37	5.40	5.17
Loam	4.63	4.72	4.96	5.11	4.86	4.88	5.13	5.38	5.47	5.22
Mean	4.41	4.53	4.75	4.87		4.70	4.92	5.19	5.30	
L.S.D. 5%	A: 0.24	B: 0.30		AB: 0.60		A: 0.36	B: 0.28		AB: 0.56	
	Number of main branches/plant									
Sand	3.20	3.41	3.53	3.57	3.43	3.16	3.34	3.51	3.68	3.42
Sand +CSH	3.23	3.43	3.64	3.72	3.51	3.54	3.63	3.75	3.91	3.71
Sand +HCN	3.41	3.74	3.80	3.90	3.71	3.60	3.81	3.89	4.12	3.86
Loam	3.67	3.98	4.36	4.54	4.14	3.67	3.88	4.06	4.28	3.97
Mean	3.38	3.64	3.83	3.93		3.49	3.67	3.81	4.00	
L.S.D. 5%	A: 0.41	B: 0.36		AB: N.S.		A: 0.36	B: 0.27		AB: N.S.	
	Herb fresh weight/plant (g)									
Sand	104.8	108.4	114.5	116.8	111.1	109.7	120.5	123.0	125.6	119.7
Sand +CSH	111.7	114.4	119.6	122.7	117.1	119.1	124.6	127.7	132.4	126.0
Sand +HCN	113.4	116.5	118.7	125.8	118.6	120.1	125.7	128.0	135.2	127.3
Loam	116.2	119.1	129.3	131.1	123.9	121.2	126.8	130.1	135.9	129.2
Mean	111.5	114.6	120.5	124.1		117.5	124.4	127.2	132.2	
L.S.D. 5%	A: 9.4	B: 7.3		AB: N.S.		A: 8.7	B:8.3		AB: N.S.	

CSH = Cotton seed hulls HCN = hyacinth plant compost

In regard with the effect of ammonium sulphate, *all of the studied* growth traits, plant height, stem diameter, branch number and herb fresh and dry weights were gradually increased by the gradual increase in applied fertilizer rate, with the best results being obtained due to the high rate (16 g/pot) in both seasons, (Tables 1 and 2). Significant differences were detected, in the two seasons, between medium , high fertilization rates and the unfertilized plants for all vegetative growth characters.

Table (2): Effect of growing media and ammonium sulphate on vegetative growth and flowering parameters of *Chrysanthemum morifolium* cv. Super Yellow during 2000 and 2001 seasons.

Growing media A	First season					Second season				
	Ammonium sulphate g/pot B					Ammonium sulphate g/pot B				
	0	4	8	16	Mean	0	4	8	16	Mean
	Herb dry weight/plant (g)									
Sand	28.2	31.6	32.2	32.7	31.2	30.4	32.1	33.2	34.0	32.4
Sand +CSH	31.4	33.3	34.7	35.5	33.7	33.0	35.4	37.1	38.3	36.0
Sand +HCN	32.5	33.4	34.5	36.6	34.3	33.7	36.1	36.6	38.5	36.3
Loam	34.0	35.8	37..6	38.2	36.4	35.0	37.5	38.3	39.7	37.6
Mean	31.5	33.5	34.8	35.8		33.0	35.3	36.3	37.6	
L.S.D. 5%	A: 2.4	B: 3.1			AB: N.S.	A: 3.0	B: 3.1			AB: N.S.
	Flowering date (day)									
Sand	151.0	157.2	157.6	158.8	156.2	154.2	160.6	161.9	162.8	159.7
Sand +CSH	154.5	160.3	161.1	162.2	159.5	156.3	163.2	163.8	165.3	162.2
Sand +HCN	156.2	161.0	162.6	163.4	160.6	158.5	164.2	165.7	167.5	164.0
Loam	161.7	167.5	169.6	172.4	167.8	164.6	169.6	170.9	173.7	169.7
Mean	155.9	161.5	162.7	164.2		158.4	164.4	165.4	167.3	
L.S.D. 5%	A: 9.4	B: 6.5			AB: N.S.	A: 8.6	B:6.8			AB:N.S.
	Flower diameter (cm)									
Sand	7.82	8.31	8.60	8.86	8.40	7.32	7.61	7.72	7.93	7.65
Sand +CSH	8.28	8.63	8.91	9.28	8.78	8.16	8.64	8.90	8.87	8.62
Sand +HCN	8.40	8.75	9.14	9.35	8.91	8.19	8.65	8.84	9.05	8.68
Loam	8.65	9.13	9.42	9.57	9.19	8.42	8.91	9.09	9.22	8.91
Mean	8.29	8.71	9.02	9.27		8.02	8.45	8.61	8.77	
L.S.D. 5%	A: 0.63	B:0.71			AB:N.S.	A: 0.77	B: 0.55			AB: N.S.
	Number of flowers/plant									
Sand	42.2	45.8	46.7	48.3	45.8	44.3	47.2	49.6	51.0	48.0
Sand +CSH	47.4	50.6	53.2	55.0	51.6	50.2	52.0	52.9	55.2	52.6
Sand +HCN	48.3	52.2	55.2	57.1	53.2	51.7	53.4	55.2	56.9	54.3
Loam	51.5	56.7	58.3	62.1	57.2	53.0	55.5	57.3	58.1	56.0
Mean	47.4	51.4	53.4	55.6		49.8	52.0	53.8	55.3	
L.S.D. 5%	A: 4.1	B: 3.6			AB: 7.2	A: 3.7	B: 3.5			AB: 7.0

CSH = Cotton seed hulls HCN = hyacinth plant compost

In agreement with these results were those revealed by Abdalla *et al.* (1991) on *Calendula officinalis*; Abd-Alazeem (1993) on *Tagetes minuata*; Adham (1997) on *Rosa polyantha*; Attia and Ahmed (1997) and Khattak *et al.* (1999) on *Chrysanthemum morifolium*; El-Mahrouk *et al.*, (1999) on *Jasminum grandiflorum*; Refaat *et al.* (2000) on borage; Badran *et al.* (2001) on *Tropaeolum majus* and Abdou *et al.* (2003) on *Calendula officinalis*. The effect of nitrogen fertilization in improving vegetative growth characteristics could be due to its vital role in supplying the plants with N required for promoting plant metabolism and activating the physiological processes which lead to enhance growth and development. Bidwell (1974) declared that nitrogen is required for growth through the production of proteins used in the formation of protoplasm for new cells, as well as, formation of chlorophyll and

cytochrome. Moreover, nitrogen application enhances the occurrence of amides, amino acids, nucleic acids, hormones and vitamins.

The interaction between growing media and ammonium sulphate rates was significant only for plant height and stem diameter in both seasons as indicated in Table (1). The tallest plants with thickest stems were those grown in sand + CSH, sand + HCN or loam and supplied with 8 or 16 g ammonium sulphate per pot.

Flowering Parameters:

Flowering date was significantly delayed due to the use of loamy soil versus sandy soil, while, the two amended sandy soils gave intermediate values. Such results were similar in the two seasons. Flowering date was delayed by 11.6 days in the first season and by 10.0 days in the second one due to loamy soil in comparison with sandy soil as clearly shown in Table (2). On the other hand, flowering date was gradually delayed parallel to the increase in ammonium sulphate rate. Significant differences were obtained due to the medium and high N-rate in comparison with unfertilized plants, (Table 2). The high N-rate delayed flowering date by 8.3 and 8.9 days in the first and second seasons, respectively. These results are in accordance with those of Al-Badawy *et al.* (1989) on *C. morifolium* and Badran *et al.* (1993) on *A. millefolium* concerning growing media; and with those of Attia and Ahmed (1997) on *C. morifolium,* Badran *et al.* (2001) on *T. majus* and Abdou *et al.* (2003) on *C. officinalis* regarding nitrogen fertilization. The interaction between the two factors, however, was not significant. The trend of delayed flowering date due to loamy soil versus sandy soil might be attributed to the fact that loamy soil, which characterized with better physical, chemical and biological properties, is more capable of producing better vegetative growth which requires longer time than that of sandy soil-grown plants. Similarly, supplying the plants with the high rate of N-fertilization encourage the plants to be taller, thicker with more branches and heavier vegetative growth than the unfertilized plants.

In relation to the flowering parameters, flower diameter, flowers number/plant and fresh weight of single and total flowers/plant, they were increased due to growing the plants in amended sandy soils, or loamy soil, as well , in comparison with those of sandy soil-grown plants. The differences were significant except that of fresh weight of single flower in the second season. In accordance with these results were those of El-Sirafy *et al.* (1989) on pepper, Al-Badawy *et al.* (1989) on *C. morifolium* and Badran *et al.* (1993) on *A. millefolium* who obtained better flowering by amending the soil with composted cotton seed hulls, akalona and/or hyacinth plants. The appreciable improve in flower parameters of amended sandy soil-grown plants is due, primarily, to the favourable effects of such amended materials on vegetative growth which reflected on flower production. Also, to the direct desirable influence of such amended materials on flower initiation and development.

In regard to ammonium sulphate fertilization, all flowering parameters under study were gradually improved by the gradual increase in the fertilizer rate in the two seasons. The differences were significant for the four flowering

parameters, except that of fresh weight of single flower in the first season as shown in Tables (2 and 3). The highest values were obtained from the high fertilization rate (16 g/pot), however, no significant differences were detected between the medium and the high fertilization rates. These results are in great harmony with those revealed by Abdalla *et al.* (1991) on *C. officinalis*, Abd-Alazeem (1993) on *T. minuata*, Adham (1997) on *R. polyantha*, Khattak *et al.* (1991) on *C. morifolium* and Refaat *et al.* (2000) on borage. The interaction between growing media and nitrogen fertilization was significant for total flowers number and total flowers fresh weight/plant in both seasons, (Tables 2 and 3). The highest values were obtained from plants grown in amended sandy soil and loamy soil and supplied with either medium or high ammonium sulphate rate.

Table (3): Effect of growing media and ammonium sulphate on flowering parameters and chemical composition of *Chrysanthemum morifolium* cv. Super Yellow during 2000 and 2001 seasons.

Growing media A	First season					Second season				
	Ammonium sulphate g/pot B					Ammonium sulphate g/pot B				
	0	4	8	16	Mean	0	4	8	16	Mean
	Fresh weight of single flower (g)									
Sand	2.10	2.12	2.17	2.20	2.15	2.03	2.15	2.21	2.24	2.16
Sand +CSH	2.17	2.20	2.25	2.27	2.22	2.12	2.17	2.25	2.28	2.21
Sand +HCN	2.22	2.25	2.26	2.28	2.25	2.14	2.20	2.24	2.27	2.21
Loam	2.25	2.29	2.32	2.34	2.30	2.21	2.23	2.26	2.30	2.25
Mean	2.19	2.22	2.25	2.27		2.13	2.19	2.24	2.27	
L.S.D. 5%	A: 0.12		B: N.S.		AB: N.S.	A:N.S.		B:0.10		AB:N.S.
	Total flowers fresh weight/plant (g)									
Sand	88.6	97.1	101.3	106.3	98.3	89.9	101.5	109.6	114.2	103.8
Sand +CSH	102.9	111.8	119.7	124.9	114.8	106.4	112.8	119.0	125.9	116.0
Sand +HCN	107.2	117.5	124.8	130.2	119.9	110.6	117.5	123.6	129.1	120.2
Loam	115.9	129.8	135.3	145.3	131.6	117.1	123.8	129.5	133.6	126.0
Mean	103.7	114.1	120.3	126.7		106.0	113.9	120.4	125.7	
L.S.D. 5%	A: 8.4		B: 10.1		AB: 20.3	A: 11.4		B: 12.0		AB: 24.1
	Chlorophyll a content (mg/g F.W.)									
Sand	2.14	2.26	2.36	2.42	2.30	2.17	2.29	2.39	2.44	2.32
Sand +CSH	2.24	2.36	2.45	2.48	2.38	2.27	2.38	2.47	2.50	2.41
Sand +HCN	2.28	2.37	2.47	2.49	2.40	2.30	2.39	2.47	2.49	2.41
Loam	2.31	2.38	2.47	2.49	2.41	2.33	2.39	2.49	2.52	2.43
Mean	2.24	2.34	2.44	2.47		2.27	2.36	2.46	2.49	
L.S.D. 5%	A: 0.08		B: 0.06		AB: 0.12	A: 0.07		B: 0.04		AB: 0.08
	Chlorophyll b content (mg/g F.W.)									
Sand	0.717	0.745	0.794	0.815	0.768	0.725	0.768	0.800	0.818	0.778
Sand +CSH	0.753	0.793	0.826	0.833	0.801	0.762	0.799	0.831	0.840	0.808
Sand +HCN	0.765	0.797	0.831	0.845	0.810	0.772	0.804	0.830	0.844	0.813
Loam	0.774	0.798	0.832	0.851	0.814	0.786	0.813	0.834	0.858	0.823
Mean	0.752	0.783	0.821	0.836		0.761	0.796	0.824	0.840	
L.S.D. 5%	A: 0.032		B: 0.050		AB: 0.101	A: 0.025		B: 0.046		AB: 0.092

CSH = Cotton seed hulls HCN = hyacinth plant compost

Chemical Composition:

The three photosynthetic pigments, chlorophyll a and b and carotenoids were significantly promoted, in the two seasons, due to growing *Chrysanthemum* plants in sand + CSH, sand + HCN or loamy soil in comparison with sand only as clearly indicated in Tables (3 and 4). These results are in accordance with the findings of Abdou (1987) on *Khaya senegalensis* and Al-Badawy *et al.* (1989) on *C. morifolium*.

Data in Tables (3 and 4) showed that chlorophyll a, chlorophyll b and carotenoids contents were gradually promoted due to the gradual increase with the applied rate of ammonium sulphate. Both medium and high N-fertilization rates were equally effective and gave significantly higher values, for the three pigments in both seasons, than those given by the unfertilized plants. In agreement with these results were those of Attia and Ahmed (1997) on *C. morifolium*, Badran *et al.*, (2001) on *T. majus* and Abdou *et al.* (2003) on *C. officinalis*.

Table (4): Effect of growing media and ammonium sulphate on chemical composition of *Chrysanthemum morifolium* cv. Super Yellow during 2000 and 2001 seasons.

Growing media A	First season					Second season				
	Ammonium sulphate g/pot B					Ammonium sulphate g/pot B				
	0	4	8	16	Mean	0	4	8	16	Mean
	Carotenoids content (mg/g F.W.)									
Sand	1.05	1.13	1.17	1.21	1.14	1.08	1.14	1.17	1.20	1.15
Sand +CSH	1.11	1.18	1.22	1.23	1.19	1.11	1.16	1.21	1.23	1.18
Sand +HCN	1.13	1.19	1.23	1.25	1.20	1.13	1.19	1.23	1.24	1.20
Loam	1.15	1.23	1.24	1.26	1.22	1.16	1.21	1.26	1.28	1.23
Mean	1.11	1.18	1.22	1.24		1.12	1.18	1.22	1.24	
L.S.D. 5%	A:0.04 B:0.05 AB: 0.11					A:0.03 B:0.04 AB:0.08				
	Herb nitrogen %									
Sand	1.41	1.76	1.86	1.92	1.74	1.65	1.97	2.06	2.16	1.96
Sand +CSH	1.68	1.95	2.04	2.10	1.94	2.01	20.9	2.18	2.25	2.13
Sand +HCN	1.71	2.02	2.08	2.18	2.00	2.07	2.16	2.21	2.28	2.18
Loam	1.78	2.07	2.15	2.22	2.06	2.11	2.25	2.29	2.39	2.26
Mean	1.65	1.95	2.03	2.11		1.96	2.12	2.19	2.27	
L.S.D. 5%	A: 0.06 B: 0.11 AB: 0.21					A: 0.09 B: 0.08 AB: 0.16				
	Herb phosphorus %									
Sand	0.211	0.280	0.295	0.325	0.278	0.238	0.301	0.316	0.332	0.297
Sand +CSH	0.351	0.363	0.369	0.382	0.366	0.360	0.371	0.385	0.393	0.377
Sand +HCN	0.358	0.372	0.384	0.395	0.377	0.377	0.384	0.402	0.409	0.393
Loam	0.383	0.390	0.396	0.406	0.394	0.392	0.404	0.414	0.423	0.408
Mean	0.326	0.351	0.361	0.377		0.342	0.365	0.379	0.389	
L.S.D. 5%	A: 0.012 B: 0.018 AB: 0.037					A: 0.015 B: 0.016 AB: 0.033				
	Herb potassium %									
Sand	2.16	2.35	2.37	2.39	2.32	2.13	2.30	2.36	2.44	2.31
Sand +CSH	2.89	2.91	2.94	3.03	2.94	2.61	2.89	2.94	3.11	2.89
Sand +HCN	3.02	3.10	3.14	3.18	3.11	2.85	3.00	3.18	3.26	3.07
Loam	3.11	3.16	3.18	3.23	3.17	2.92	3.10	3.17	3.32	3.13
Mean	2.80	2.88	2.91	2.96		2.63	2.82	2.91	3.03	
L.S.D. 5%	A: 0.08 B: 0.06 AB: 0.13					A: 0.14 B: 0.09 AB: 0.18				

CSH = Cotton seed hulls HCN = hyacinth plant compost

The interaction between growing media and ammonium sulphate rates was significant in the two seasons for the three studied photosynthetic pigments. The highest values were given due to the interaction between sand + CSH, sand + HCN or loamy soil with either medium or high ammonium sulphate rates as clearly indicated in Tables (3 and 4).

Concerning the herb % of nitrogen, phosphorus and potassium, they were significantly increased in the two seasons as a result of using any one of the two amended sandy soils or the loamy soil in comparison with the plain sandy soil as clearly shown in Table (4). Among the tow amended sandy soils that amended with hyacinth plants compost gave relatively higher N, P and K herb % than that amended with cotton seed hulls compost. The trend of increasing nutrients % in plant herb due to the use of composted materials was observed by Abdou (1987) on *K. senegalensis* and Al-Badawy *et al.*, (1989) on C. *morifolium*.

Nitrogen, phosphorus and potassium % in the herb were also significantly increased, in both seasons, due to the use of any one of the three applied ammonium sulphate rates, in comparison with the unfertilized treatment, (Table 4). However, the increase in the three nutrients % was parallel to the increase in the nitrogen applied rate. These results were in agreement with the findings of El-Marhrouk *et al.* (1999), Badran *et al.* (2001) and Abdou *et al.* (2003) on *J. grandiflorum*, *T. majus* and *C. officinalis*, respectively.

The interaction between growing media and ammonium sulphate was significant in both seasons for the three nutrients herb %, with the highest values being mostly obtained from sand + HCN or loamy soil in combination with the high ammonium sulphate rate (16 g/pot) as shown in Table (4).

The role of composted organic materials and that of nitrogen fertilization in promoting different vegetative characters and flowering parameters as explained previously, were also responsible for increasing both photosynthetic pigments and the percent of nitrogen, phosphorus and potassium in the herb of *Chrysanthemum morifolium* plants.

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النمو والتزهير فى نباتات الأراولا:
١ - تأثير بيئات النمو وسلفات النشادر على الأراولا صنف سوبرأصفر

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أجريت تجربة أصص خلال موسمى ٢٠٠٠ ، ٢٠٠١ المتتابعين لمعرفة استجابة الاراولا صنف سوبر أصفر النامية فى أربعة بيئات نمو (رمل ، رمل + قشرة بذرة القطن ، رمل + نباتات ورد النيل ، طمى) لأربعة مستويات سمادية من سلفات النشادر (صفـــر ، ٤ ، ٨ ، ١٦ جـــرام للأصيص.

أظهرت النتائج أن نمو نباتات الأراولا على بيئات الرمل + قشرة بذرة القطن أو الرمـل + نباتات ورد النيل أو الطمى قد أعطت زيادة كبيرة فى صفات النمو الخضرى والزهرى ومحتوى صبغات التمثيل الضوئى ومحتوى العشب من كل من النيتروجين والفوسفور والبوتاسيوم بالمقارنـة بنتائج التربة الرملية . ولقد ظهر أن نتائج الزراعة فى التربة الرملية المعدلة بقشرة بذور القطن أو ورد النيل كانت متقاربة لتلك الناتجة من الزراعة فى التربة الطميية. ومع ذلك فقد تسببت التربـــة الطميية فى تأخير ميعادالتزهير عن التربة الرملية

أما بالنسبة لمعاملات سلفات النشادر فإن الزيادة التدريجية فى هذا السماد قد تسببت فـــى زيادة تدريجية فى كل الصفات الخضرية وانتاج الأزهار والمكونات الكيماويـــة ولكـــن المســـتوى العالى من سلفات النشادر قد تسبب فى تأخير ميعاد التزهير لنباتات الأراولا .