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GROWTH AND FLOWERING OF *Chrysanthemum morifolium* PLANTS:
II. EFFECT OF N-MINERAL/N-BIOFERTILIZER AND MICRONUTRIENTS ON *Chrysanthemum morifolium* ICECAP.

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ABSTRACT

A pot experiment was conducted during 2001 and 2002 seasons to explore the response of *Chrysanthemum morifolium* plants to N-mineral- and/or bio-fertilizer treatments, as well as, Fe and Zn concentrations.

Both ammonium sulphate (9.6 g/pot or ammonium sulphate 4.8 g/pot + nitrobein) effectively increased different vegetative growth characters, promoted flowering parameters and stimulated various chemical constituents such as N, Fe and Zn % and carbohydrates and chlorophylls contents in the leaves. Similarly, Fe or Zn gave rise to most pre-mentioned vegetative growth, flowering and chemical constituents. In general, the combined treatment consisting of ½ dose ammonium sulphate (4.8 g/pot) + nitrobein plus Fe at 80 ppm or Zn at 50 ppm gave reasonable vegetative growth and best quality and quantity of flower production.

INTRODUCTION

Chrysanthemum morifolium, Ramat, plants belong to Fam. Asteraceae and considered the most desirable of all autumn blooming perennials for borders, containers and cut flowers, and the most versatile and varied of all *Chrysanthemum* species available in many flower forms, sizes, color and growth habits. One of the favourate and attractive varieties introduced to Egypt throughout Egypt-California Project for Agric. and Development is *Chrysanthemum morifolium*, Ramat. Icecap.

The substitution of, at least, part of the mineral N-fertilizers by some N-fixing bacteria fertilizers is, economically and environmentally, greatly desired. In addition, the supplement of such plants, especially those grown under sandy soil conditions, with some micronutrients should be beneficial for obtaining better growth and flowering characteristics.

Concerning chemical N-fertilization, many authors revealed the role of such fertilizers at various sources and rates in increasing vegetative growth traits, enhancing flowers quality and stimulating leaves content of nitrogen, photosynthetic pigments and carbohydrates, as well as, delaying flowering date. Examples are Badran *et al.* (1989) on borage, Aly *et al.* (1989) on *Chrysanthemum*, El-Sayed (1991) on *Calendula officinalis*, Attia and Ahmed (1997) on *Chrysanthemum*, Badran *et al.* (2001) on *Tropaeolum majus*, Abdou *et al.* (2003) on *Calendula officinalis* and Abdou and Hassanein (2003) on *Jasminum sambac*. Meanwhile, nitrogen fixing bacteria biofertilizers were also effective in promoting different vegetative, flowering and chemical composition parameters like those on tomato (Barakat and Gabr, 1998), apple (Mansour, 1998), squash (Abd-Elfattah and Sorial, 2000), anise (Soliman, 2002) and *Calendula officinalis* (Hassanein *et al.* 2003). Concerning the efficiency of different micronutrients, zinc and ferrous in particular, their beneficial role in producing better growth and flower characters, earliness of flowering date and increasing leaf contents of N, Zn, Fe and/or photosynthetic pigments was reported by Badran *et al.* (1993) on *Achillea millefolium*, Mostafa (1996) on carnation, Mostafa *et al.* (1997) on *Chrysanthemum morifolium* , Manoly (2000) on gladiolus, Manoly (2001) on *Zinnia elegans* and El-Sayed *et al.* (2001) on sunflower.

MATERIALS AND METHODS

This study was carried out at the nursery of Fac. of Agric., Minia Univ. during the two successive seasons of 2001 and 2002. Uniform size cuttings of *Chrysanthemum morifolium*, Ramat cv. Icecap with an average length of 8 cm were planted in seedpans filled with a mixture of equal amounts of loamy and sandy soils (1:1 v/v) and placed in the greenhouse on the first week of Feb. of both seasons. On April 5^{th} 2001 and 2002, the rooted cuttings were planted, individually, in 10-cm clay pots filled with a mixture of loamy soil, sandy soil and organic manure at 1:1:1 by volume. The chemical analysis of used organic manure is shown in Table (A). Two months later, the seedlings were transplanted into 25-cm clay pots filled with 5 kg/pot of the same soil mixture used before. Two weeks from transplanting, the plants were pinched out.

Table(A): Chemical analysis of used organic manure.

Content	N %	P %	K %	Fe (ppm)	Mn (ppm)	Zn (ppm)	E. C. (mmhos)	PH	O. M %
Value	1.65	0.51	0.96	3895	373	79	9.71	7.3	21.2

A split plot design with three replicates (five plants in each replicate) was followed where four N-fertilizer treatments consisted the main plots and five micronutrient treatments were assigned to the sub-plots. The four N-fertilization treatments were control, 9.6 g/pot ammonium sulphate (20.6% N), 5 g/pot nitrobein and both ammonium sulphate at 4.8 g/pot + nitrobein at 5 g/pot were added once 3 weeks after transplanting. While, the five micronutrient treatments were control, 80 ppm Fe, 160 ppm Fe, 25 ppm Zn and 50 ppm Zn. Both micronutrients were used in the form of Fe-EDTA and Zn-EDTA. All micronutrient treatments were sprayed 4 weeks after transplanting and repeated twice at 3 week intervals. All plants, including control ones, were supplied with calcium superphosphate (15.5 % P_2O_5) and potassium sulphate (48.5% K_2O) at the rate of 10.8 and 5.4 g/pot, respectively. Such phosphorus and potassium fertilizers were added before transplanting.

The data were recorded for plant height(cm), stem diameter(mm), number of branches and leaves/plant, dry weight of leaves/plant, flowering date (time taken from final transplanting till colour showing stage), flowering duration (showing flower colour to flower fading), number of flowers/plant flower diameter and flowers dry weight/plant. In addition, chemical analysis were conducted to determine each of total carbohydrates according to (Dubios *et al.*, 1956); N% (A.O.A.C., 1980); Fe and Zn (atomic absorption spectrophotometer described by Chapman and Pratt, 1961) and chlorophylls (Fadl and Seri-Eldeen, 1978). Obtained data were statistically analyzed using ANOVA test method as described by Snedecor and Cochran (1973).

RESULTS AND DISCUSSION

Vegetative growth characters:

All studied vegetative growth characters, namely, plant height, stem diameter, number of branches and leaves/plant and leaves dry weight/plant were significantly increased in the two seasons due to the application of N-chemical fertilizer, N-biofertilizer and the combined treatment of both fertilizers in comparison with those of unfertilized plants as shown in Tables (1 and 2). However, the N-chemical treatment and the mixed one gave the highest values with no significant differences among them. These results are in agreement with those of Badran *et al.* (1989) on borage, Aly *et al.* (1989) *on Chrysanthemum morifolium*, El-Sayed (1991) on *Calendula officinalis*, Attia and Ahmed (1997) on *Chrysanthemum morifolium*, Badran *et al.* (2001) on *T. majus* and Abdou *et al.* (2003) on *Calendula officinalis* for chemical N-fertilization; and are in accordance with those revealed by Barakat and Gabr (1998) on tomato, Abd-Elfattah and Sorial (2000) on squash, Soliman (2002) on anise and Hassanein *et al.* (2003) on *Calendula officinalis* in regard with N-biofertilization.

The four micronutrient treatments were also effective in augmenting all of the pre-mentioned vegetative growth characters significantly in both seasons over those of unfertilized plants. Moreover, Fe at 80 ppm and Zn at 50 ppm proved to be the most effective treatments among different micronutrient ones in the two seasons as clearly shown in Tables (1 and 2). The efficiency of Fe and/or Zn in promoting different vegetative growth characters was reported on *Achillea millefolium* (Badran *et al.*, 1993); carnation (Mostafa, 1996); *Chrysanthemum morifolium* (Mostafa *et al.*, 1997) and *Zinnia elegans* (Manoly, 2001).

The interaction between N-fertilization and micronutrients was significant, in both seasons, for the five growth characters as indicated in Tables (1 and 2). The best results were obtained due to the use of N-chemical or N-chemical + biofertilizer in combination with Fe 80 ppm or Zn 50 ppm.

Flowering parameters:

Table (2) showed that flowering date was not significantly affected by either N-fertilization treatments or micronutrient treatments in the two seasons. However a trend of delayed flowering due to N-fertilization and produced early flowering due to micronutrients could be observed.

Table (1): Effect of N-fertilization and micronutrients on vegetative growth of *Chrysanthemum morifolium*, Ramat. cv. Icecap during 2001 and 2002 seasons.

Micro-nutrient treats B	First seasons					Second seasons				
	N-Fertilization treatments A					N-Fertilization treatments A				
	Cont.	Chem.	Bio.	Ch+Bi	Mean B	Cont.	Chem.	Bio.	Ch+Bi	Mean B
	Plant height (cm)									
Control	51.3	66.3	55.4	64.5	59.4	54.5	69.0	58.0	67.5	62.3
Fe 80	57.4	73.2	62.3	72.6	66.4	59.6	76.1	63.5	76.1	68.8
Fe 160	55.5	71.4	60.7	71.1	64.7	57.7	75.0	62.0	74.7	67.4
Zn 25	54.6	71.9	59.5	70.0	64.0	56.6	74.1	61.4	73.6	66.4
Zn 50	56.7	73.8	62.8	73.3	66.7	60.0	77.5	64.1	77.1	69.7
Mean A	55.1	71.3	60.1	70.3		57.7	74.3	61.8	73.8	
L.S.D. 5%	A:4.8	B: 4.3		AB: 8.7		A: 4.0		B: 3.8		AB: 7.6
	Stem diameter (mm)									
Control	4.52	6.23	4.90	5.91	5.39	4.23	6.02	4.71	5.81	5.19
Fe 80	5.34	6.80	5.71	6.78	6.15	4.96	6.77	5.38	6.44	5.89
Fe 160	5.17	6.77	5.42	6.67	6.01	4.75	6.66	5.24	6.34	5.75
Zn 25	5.02	6.69	5.35	6.42	5.87	4.58	6.56	5.25	6.46	5.71
Zn 50	5.43	7.08	5.72	6.85	6.27	5.01	6.80	5.53	6.75	6.02
Mean A	5.10	6.71	5.42	6.53		4.71	6.56	5.22	6.36	
L.S.D. 5%	A:0.26	B: 0.41		AB: 0.83		A: 0.43		B: 0.48		AB:0.96
	Number of branches/plant									
Control	4.50	6.35	4.90	6.14	5.47	4.94	6.76	5.44	6.53	5.92
Fe 80	5.12	7.15	5.54	7.02	6.21	5.59	7.57	6.12	7.38	6.67
Fe 160	5.04	7.05	5.45	6.88	6.11	5.50	7.48	6.03	7.30	6.58
Zn 25	4.89	6.99	5.36	6.84	6.02	5.39	7.41	5.95	7.21	6.49
Zn 50	5.19	7.19	5.62	7.06	6.27	5.68	7.63	6.21	7.44	6.74
Mean A	4.95	6.95	5.37	6.79		5.42	7.37	5.95	7.17	
L.S.D. 5%	A:0.41	B: 0.52		AB: 1.03		A: 0.47		B: 0.56		AB: 1.12

The role of N-chemical fertilizers in delaying flowering was reported by Badran *et al.* (1989) on borage, Aly *et al.* (1989) on *Ch. morifolium*, El-Sayed (1991) on *C. officinalis* and Attia and Ahmed (1997) on *Ch. morifolium*, and that N-biofertilizers was pointed out by Abd-Elfattah and Sorial (2000) on squash and Hassanein *et al.* (2003) on *C. officinalis*. On the other hand, Badran *et al.* (1993), Mostafa (1996) and Manoly (2000) on *A. millefolium*, carnation and gladiolus, respectively, concluded the role of Fe and/or Zn in producing early flowers.

Flowering duration was significantly increased due to either ammonium sulphate or ammonium sulphate (½ dose) + nitrobein in comparison with untreated plants. Such parameter was also significantly increased due to the use of Fe or Zn at both concentrations each over that of untreated plants. These results were identical in both seasons as shown in Table (3). However, the interaction between the two studied factors was not significant in the two seasons.

Concerning both flowers number and dry weight / plant, they were significantly increased due to the three N-fertilization treatments over those of unfertilized plants in the two seasons (Tables 3 and 4).

Table (2): Effect of N-fertilization and micronutrients on vegetative growth and flowering date of *Chrysanthemum morifolium*, Ramat. cv. Icecap during 2001 and 2002 seasons.

Micro-nutrient treats B	First seasons					Second seasons				
	N-Fertilization treatments A					N-Fertilization treatments A				
	Cont.	Chem.	Bio.	Ch+Bi	Mean B	Cont.	Chem.	Bio.	Ch+Bi	Mean B
	Number of leaves/plant									
Control	28.2	38.7	31.3	37.2	33.9	30.5	42.6	34.0	40.1	36.8
Fe 80	34.3	46.4	36.1	44.2	40.3	36.0	49.5	39.1	47.3	43.0
Fe 160	33.9	43.5	35.4	41.9	38.7	35.5	47.7	38.1	45.9	41.8
Zn 25	31.2	43.8	36.3	42.0	38.3	35.0	46.8	37.1	45.2	41.0
Zn 50	34.4	47.6	37.3	45.2	41.1	37.0	50.6	39.5	48.2	43.8
Mean A	32.4	44.0	35.3	42.1		34.8	47.4	37.6	45.3	
L.S.D. 5%	A:2.8	B: 3.9		AB: 7.8		A: 2.5		B: 3.6		AB: 7.2
	Leaves dry weight/plant (g)									
Control	6.86	8.89	7.51	8.56	7.96	7.08	9.44	7.81	9.02	8.34
Fe 80	8.69	10.71	9.03	10.37	9.70	8.64	11.69	9.41	11.25	10.25
Fe 160	8.40	10.05	8.78	9.77	9.25	8.48	10.87	9.11	10.55	9.75
Zn 25	8.20	10.04	9.45	10.08	9.19	8.33	10.57	8.86	10.31	9.52
Zn 50	9.17	10.95	9.76	10.85	10.18	9.23	11.96	9.53	11.53	10.56
Mean A	8.26	10.13	8.91	9.93		8.35	10.91	8.94	10.53	
L.S.D. 5%	A:0.60	B: 0.62		AB: 1.24		A: 0.51		B: 0.54		AB: 1.07
	Flowering date (day)									
Control	208.0	212.1	209.8	211.6	210.4	209.5	214.8	211.7	214.1	212.5
Fe 80	207.0	211.5	208.1	210.5	209.3	206.5	213.3	209.7	212.3	210.5
Fe 160	207.6	211.7	208.2	210.8	209.6	208.0	213.6	210.2	212.7	211.1
Zn 25	206.5	211.5	207.7	211.1	209.2	206.1	212.6	208.7	211.1	209.6
Zn 50	205.0	211.0	207.3	210.5	208.5	205.4	212.1	208.2	212.1	209.5
Mean A	206.8	211.6	208.2	210.9		207.1	213.3	209.7	212.5	
L.S.D. 5%	A:N.S.	B: N.S.		AB: N.S.		A: N.S.		B: N.S.		AB: N.S.

Numerically, number of flowers/plant was increased by 60.0 and 49.4% in the first and second seasons due to ammonium sulphate and by 52.6 and 44.2% due to ½ dose ammonium sulphate + nitrobein over that of unfertilized plants. Corresponding increases in flowers dry weight/plant reached 63.1 and 49.8% for N-chemical fertilizer and 57.2 and 46.6% for ½ N-chemical + N-biofertilizer, in the two seasons, respectively. In regard to micronutrients, all examined treatments caused significant increase in both number and dry weight of flowers/plant in the two seasons with Fe at 80 ppm and Zn at 50 ppm giving the highest number and the heaviest dry weight of flowers/plant. Flower diameter was also increased due to either N-fertilization or micronutrients.

But the differences were significant only for N-fertilization treatments, especially due to ammonium sulphate, as well as, ½ dose ammonium sulphate + nitrobein in the two seasons as shown in Table (3). In accordance with these results concerning N-chemical fertilization were those of Aly *et al.* (1989) and Attia and Ahmed (1997) on *Ch. morifolium*, Badran *et al.* (2001)

on *T. majus*, Abdou *et al.* (2003) on *C. officinalis* and Abdou and Hassanein (2003) on *Jasminum sambac*; and regarding N-biofertilization were those of Barakat and Gabr (1998) on tomato, Abd-Elfattah and Sorial (2000) on squash and Hassanein *et al.* (2003) on *C. officinalis*. While, the role of Fe and/or Zn in enhancing flower production was stated by Badran *et al.* (1993) on *A. millefolium*, Mostafa (1996) on carnation, Mostafa *et al.* (1997) on *Ch. morifolium* and El-Sayed *et al.* (2001) on sunflower.

Table (3): Effect of N-fertilization and micronutrients on flowering parameters of *Chrysanthemum morifolium*, Ramat. cv. Icecap during 2001 and 2002 seasons.

Micro-nutrient treats B	First seasons					Second seasons				
	N-Fertilization treatments A					N-Fertilization treatments A				
	Cont.	Chem.	Bio.	Ch+Bi	Mean B	Cont.	Chem.	Bio.	Ch+Bi	Mean B
	Flowering duration (day)									
Control	24.6	27.7	26.1	26.8	26.3	26.2	30.0	28.0	28.9	28.3
Fe 80	28.1	32.2	29.9	30.9	30.3	28.9	33.4	30.9	32.2	31.4
Fe 160	27.7	31.9	29.4	30.5	29.9	29.5	32.7	31.4	32.9	31.6
Zn 25	27.1	30.7	28.7	29.5	29.0	28.8	31.8	30.7	31.8	30.8
Zn 50	28.0	31.6	29.6	30.6	30.0	29.6	32.6	31.7	32.9	31.7
Mean A	27.1	30.8	28.7	29.7		28.6	32.1	30.5	31.7	
L.S.D. 5%	A:2.5	B: 2.3		AB: N.S.		A: 2.9		B: 2.1		AB: N.S.
	Number of flowers/plant									
Control	10.4	19.0	14.2	18.1	15.4	12.4	21.0	16.0	19.5	17.2
Fe 80	14.5	22.5	16.6	21.5	18.8	16.8	24.2	18.7	23.6	20.8
Fe 160	14.1	21.6	15.8	20.6	18.0	16.0	23.1	17.5	22.6	19.8
Zn 25	13.8	21.4	15.6	20.4	17.8	15.1	22.9	17.3	22.4	19.4
Zn 50	14.7	23.4	16.9	22.6	19.4	17.6	25.2	19.3	24.5	21.7
Mean A	13.5	21.6	15.8	20.6		15.6	23.3	17.8	22.5	
L.S.D. 5%	A:1.7	B: 1.4		AB: 2.8		A: 1.9		B: 1.4		AB: 2.8
	Flower diameter (cm)									
Control	3.50	4.00	3.62	3.87	3.75	3.71	4.18	3.85	4.09	3.96
Fe 80	3.81	4.26	3.90	4.12	4.02	3.90	4.38	4.12	4.33	4.18
Fe 160	3.72	4.17	3.80	4.03	3.93	3.83	4.28	4.05	4.24	4.10
Zn 25	3.68	4.17	3.80	4.02	3.92	3.83	4.25	4.03	4.24	4.09
Zn 50	3.82	4.27	3.93	4.12	4.04	3.92	4.41	4.13	4.34	4.20
Mean A	3.71	4.17	3.81	4.03		3.84	4.30	4.04	4.25	
L.S.D. 5%	A:0.31	B: N.S.		AB: N.S.		A: 0.38		B: N.S.		AB: N.S.

Chemical constituents:-

The five studied chemical constituents, total carbohydrates content, nitrogen, ferrous and zinc % and total chlorophylls content were significantly promoted due to the application of ammonium sulphate or ammonium sulphate (½ dose) + nitrobein in both seasons. Such two treatments were almost equal in their effectiveness in increasing these chemical constituents in the two seasons as shown in Table (4 and 5). In regard to micronutrient treatments, significant differences were detected in the two seasons for the five chemical determinations. It is worth to mention that Fe % was remarkably increased due to the application of Fe at both concentrations, while Zn % was considerably increased due to Zn application at both concentrations as clearly shown in Table (5).

Table (4): Effect of N-fertilization and micronutrients on flowering parameters and chemical constituents of *Chrysanthemum morifolium*, Ramat. cv. Icecap during 2001 and 2002 seasons.

Micro-nutrient treats B	First seasons					Second seasons				
	N-Fertilization treatments A					N-Fertilization treatments A				
	Cont.	Chem.	Bio.	Ch+Bi	Mean B	Cont.	Chem.	Bio.	Ch+Bi	Mean B
	Flowers dry weight/plant (g)									
Control	2.90	5.52	3.97	5.21	4.40	3.44	5.97	4.40	5.54	4.84
Fe 80	4.24	6.69	4.88	6.44	5.56	4.86	6.93	5.43	6.92	6.04
Fe 160	4.09	6.36	4.59	6.14	5.30	4.56	6.59	4.97	6.56	5.67
Zn 25	3.97	6.28	4.49	6.07	5.20	4.23	6.54	4.92	6.49	5.55
Zn 50	4.32	6.94	5.00	6.77	5.76	5.12	7.22	5.58	7.02	6.24
Mean A	3.90	6.36	4.59	6.13		4.44	6.65	5.06	6.51	
L.S.D. 5%	A:0.42	B: 0.36	AB: 0.72			A: 0.52	B: 0.47	AB: 0.95		
	Total carbohydrates content (mg/g D.W.)									
Control	33.1	35.5	35.2	35.3	34.8	34.6	37.2	36.5	37.1	36.4
Fe 80	34.7	37.5	37.2	37.3	36.7	36.4	39.1	38.3	39.0	38.2
Fe 160	34.7	37.6	37.3	37.4	36.8	36.4	39.0	38.3	39.0	38.2
Zn 25	34.6	37.7	36.6	36.7	36.4	36.0	38.7	37.8	38.9	37.9
Zn 50	34.7	37.7	37.3	37.4	36.8	36.5	39.1	38.3	39.5	38.4
Mean A	34.4	37.2	36.7	36.8		36.0	38.6	37.8	38.7	
L.S.D. 5%	A:1.6	B: 1.4	AB:N.S.			A: 1.3	B: 1.2	AB: N.S.		
	Nitrogen %									
Control	1.210	1.913	1.514	1.824	1.615	1.260	1.931	1.467	1.826	1.621
Fe 80	1.273	1.956	1.572	1.893	1.674	1.316	1.977	1.534	1.888	1.679
Fe 160	1.263	1.951	1.561	1.885	1.665	1.352	1.961	1.512	1.873	1.675
Zn 25	1.258	1.945	1.564	1.878	1.661	1.293	1.957	1.503	1.879	1.658
Zn 50	1.281	1.967	1.580	1.904	1.683	1.320	1.975	1.544	1.898	1.684
Mean A	1.257	1.946	1.560	1.877		1.308	1.960	1.512	1.873	
L.S.D. 5%	A:0.081	B: 0.050	AB: N.S.			A: 0.066	B: 0.048	AB: N.S.		

The interaction between N-fertilization and micronutrients was significant only for Fe % and Zn % in the two seasons with the best results for Fe % due to N-chemical/biofertilizer xFe at 160 ppm and for Zn % due to N-chemical/biofertilizer xZn at 50 ppm.

Different authors reported the role of N-chemical fertilization in increasing carbohydrates (El-Sayed, 1991 on *C. officinalis* and Attia and Ahmed, 1997 on *Ch. morifolium*); N% (Badran *et al.*, 1989 on borage, Attia and Ahmed, 1997 on *Ch. morifolium*, Badran *et al.*, 2001 on *T. majus*, Abdou *et al.*, 2003 on *C. officinalis* and Abdou and Hassanein, 2003 on *J. sambac*) and chlorophylls (Aly *et al.*, 1989 on *Ch. morifolium*, Badran *et al.*, 2001 on *T. majus* and Abdou and Hassanein, 2003 on *J. sambac*). While, the role of N-biofertilizers in promoting N% and chlorophylls was revealed by Mansour (1989) on apple, Barakat and Gabr (1998) on tomato, Soliman (2002) on anise and Hassanein *et al.*, (2003) on *C. officinalis*. Meanwhile, the effective role of Fe and/or Zn in promoting N, Fe and Zn % and chlorophylls was indicated by Mostafa (1997) on *Ch. morifolium*, El-Sayed *et al.*, (2001) on sunflower and Manoly (2001) on *Z. elegans.*

Table (5): Effect of N-fertilization and micronutrients on chemical constituents of *Chrysanthemum morifolium*, Ramat. cv. Icecap during 2001 and 2002 seasons.

Micro-nutrient treats B	First seasons					Second seasons				
	N-Fertilization treatments A					N-Fertilization treatments A				
	Cont.	Chem.	Bio.	Ch+Bi	Mean B	Cont.	Chem.	Bio.	Ch+Bi	Mean B
	Ferrous %									
Control	49.7	89.7	61.1	91.6	73.0	51.6	88.3	60.0	93.4	73.3
Fe 80	124.8	171.4	151.2	190.7	159.5	126.5	167.7	148.1	193.4	158.9
Fe 160	234.7	245.0	273.6	304.7	264.5	230.7	241.8	261.8	306.6	260.2
Zn 25	39.8	59.4	53.2	62.0	53.6	40.5	57.6	50.0	60.5	52.2
Zn 50	34.6	39.7	35.8	52.7	40.7	32.8	37.4	32.9	50.5	38.4
Mean A	96.7	121.0	115.0	140.3		96.4	118.6	110.6	140.9	
L.S.D. 5%	A:8.1	B: 6.4		AB: 12.8		A: 10.7		B: 10.2		AB: 20.5
	Zinc %									
Control	30.5	41.3	32.6	43.3	36.9	31.2	40.8	32.7	45.2	37.5
Fe 80	41.9	57.4	45.0	61.5	51.5	43.8	57.0	44.5	62.0	51.8
Fe 160	33.0	36.6	28.3	39.5	34.4	30.4	36.3	28.0	42.5	34.3
Zn 25	111.7	120.9	117.6	122.5	118.2	115.4	119.1	117.1	126.1	119.4
Zn 50	124.9	131.5	129.4	133.1	129.7	124.0	130.8	128.0	135.0	129.5
Mean A	68.4	77.5	70.6	80.0		69.0	76.8	70.1	82.2	
L.S.D. 5%	A:4.2	B: 8.2		AB: 16.3		A: 3.9		B: 6.6		AB: 13.3
	Total chlorophylls content (mg/g F.W.)									
Control	2.145	2.481	2.295	2.423	2.336	2.238	2.609	2.419	2.553	2.455
Fe 80	2.461	2.733	2.585	2.655	2.609	2.585	2.828	2.692	2.765	2.718
Fe 160	2.520	2.814	2.649	2.766	2.688	2.641	2.908	2.741	2.823	2.778
Zn 25	2.287	2.624	2.492	2.576	2.495	2.406	2.737	2.603	2.691	2.609
Zn 50	2.332	2.688	2.569	2.645	2.561	2.440	2.774	2.647	2.701	2.641
Mean A	2.349	2.668	2.518	2.613		2.462	2.771	2.620	2.707	
L.S.D. 5%	A:0.107	B: 0.097		AB:N.S.		A:0.094		B:0.088		AB:N.S.

The appreciable increase in different vegetative growth characters, flowering parameters and chemical constituents of *Chrysanthemum morifolium* plants due to the use of N-chemical fertilization might be explained in the light of the vital physiological roles of nitrogen element in different growth and development processes. It is a constituent of the protoplasm, so more available nitrogen supply would activate the meristematic system due to the increase in cell number and size, thereby stimulates vegetative growth, and by sequence flowering aspects. Moreover, the increase in vegetative growth promotes the photosynthesis, more pigmentation, carbohydrate formation and translocation. The stimulation of root growth encourages the absorption of different macro-and micronutrients needed for growth and development. An explanation to the role of nitrobein in promoting vegetative growth, flowering and chemical constituents including N, Fe and Zn %, as well as, carbohydrates and chlorophylls contents might be due to the fact that nitrobein contains nonsymbiotic N_2-fixing bacteria which affects the host plant by one mechanism or more such as nitrogen fixation, production of growth promoting substances such as organic acids, enhancing nutrients uptake and/or stimulating photosynthesis, (El-Haddad *et al.*, 1993).

Regarding Fe and Zn roles in promoting growth, flowering and chemical constituents of the plants, ferrous is involved in the metabolism of chloroplast RNA, necessary for biosynthesis of chlorophyll and cytochrome, acting as a prosthetic group in the enzymes that playing a role in the energy conversation and is an essential component in many enzymes and carriers, (Epstein, 1972). On the other hand, zinc is essential for the synthesis of tryptophan, a precursor of auxin, required for the maintenance of auxin in an active state, component of carbonic anhydrase and function in CO_2 assimilation, (Isarangkura, 1978).

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النمو والتزهير فى نباتات الاراولا:

٢- تأثير التسميد النيتروجينى المعدنى والحيوى والعناصر الصغرىعلـــى الاراولا ايس كاب

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تم إجراء تجربة أصص خلال موسمى ٢٠٠١ ، ٢٠٠٢ لدراسة مدى اســـتجابة نباتات الاراولا للتسميد النيتروجينى المعدن والحيوى وكذلك الحديد والزنـــك بتركـيزات مختلفة .

وجد أن سلفات الأمونيوم (٩,٦ جرام للأصيص) أو ســـلفات الأمونيـوم (٤,٨ جرام للأصيص) + السماد الحيوى نتروبين كانت فعالة فـــى زيـادة مختلـف الصفـات الخضرية والقياسات الزهرية والمكونات الكيماوية مثل نسبة النيتروجين والحديد والزنـــك فى الأوراق وكذلك محتوى الأوراق من الكربوهيدرات وصبغات التمثيل الضوئى. وبالمثل فان كلا من الحديد أو الزنك قد زادت من الصفات السابقة سواء الخضرية أو الزهريـة أو المكونات الكيماوية . وعموما فان معاملة التداخل المكونة من ٤,٨ جرام سلفات أمونيوم + نتروبين بالتداخل مع الحديد ٨٠ جزء فى المليون أو الزنك بتركيز ٥٠ جزء فى المليـون أعطت نموا خضريا جيدا وافضل إنتاج زهرى نوعا وكما.