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EFFECT OF FOLIAR APPLICATION WITH SOME MICRO-ELEMENTS ON GROWTH, FLOWERING AND CHEMICAL COMPOSITION OF *CRINUM ASIATICUM*, Thumb PLANT

BY

Hasnaa A.H. Gouda
National Organization for Drug Control and Research (NODCAR).

ABSTRACT

Two field experiments were carried out at the Faculty of Agriculture at Moshtohor, Benha University on *Crinum asiaticum* plant during the two successive seasons of 2004 and 2005 to study the response this plant to foliar spray with manganese at rates of 100, 150 and 200 ppm, boron at rates of 50, 75 and 100 ppm, combined with zinc at rates of 100 and 200 ppm, on vegetative growth, flowering, bulb parameters and chemical composition.

The obtained results were summarized as follows:

All applied concentrations of microelements significantly increased number, fresh and dry weights of leaves/plant. The best results were obtained from treatments of Zn at 200 ppm combined with Mn or B at the highest concentrations. All applied concentrations of microelements improved the measurement of flowering i.e. number of days to full blooming, number, diameter, fresh weight of flowers/flowering stalk and vase life of flower (days). The highest mean values in this concern were obtained by using the highest concentration of microelements especially Zn at 200 ppm combined with Mn at the same concentration. With regard to flowering stalk parameters i.e. length, diameter, number, fresh and dry weights of flowering stalk/plant, results showed that Zn at 200 ppm combined with Mn at 200 ppm gave the best results in this concern. In addition all tested applications of microelements increased chemical content in leaves and bulbs such as total nitrogen, phosphorous, potassium and total carbohydrates. Also total alkaloids in leaves and bulbs were increased by using all treatments especially Zn combined with Mn at 200 ppm concentration for each. The best results of number, diameter, fresh and dry weights of bulbs/plant were gained by spraying plants with the high concentration of microelements especially zinc at 200 ppm combined with manganese at the same concentration comparing with control plants. It is recommended to spray zinc combined with manganese (each at 200 ppm) to obtain the best plant growth, flowering, bulbs productivity and chemical composition of *Crinum asiaticum*.

INTRODUCTION

Crinum asiaticum, Thumb. (Fam. Amaryllidaceae) is considered an ornamental flowering bulbs, perennial herbaceous with long-necked, ovoid true bulbs, native tropical and subtropical regions throughout the world. Crinum is grown successfully in Egypt, mostly outdoors, as a flower bed impact or in

borders. The large showy, pure white, funnel-shapped flowers, in umbel terminal on a stout, fleshy stalk or peduncle, appear with the leaves or after, the foliage is well grown, mostly in early summer and lasts for 8-10 weeks, nearly (Bailey, 1976). Over 100 distinctly different alkaloid have been reported from the roots, bulbs, leaves, fruits and seeds of about 150 species belonging to 36 genera of this family (Ghosal *et al.*, 1985 and 1987). Ghosal *et al.* (1990) reported that the phenanthridine alkaloids, lycorine and its analogues, normally present in the form of conjugates (glycosides and phosphatidyl derivatives in Amaryllidaccae plants). Most effects of Amaryllidaceae alkaloids are: analgesic, anticholinergic, anticancer, immunostimulatory, anti-inactive, cardiovascular and emetic and diaphoretic activities, among other pharmacological effects of alkaloids from Crinum spp. (Fennell and Staden, 2001).

Bastida, *et al.* (1998) reported that lycorine the main alkaloid has various biological and pharmacological activities., Campbell *et al.* (1998) indicated that it has antimalarial also inflammatory (Citoglu *et al.*, 1998, Samud *et al.*, 1999 and Elgorashi *et al.*, 2003) and antitumour activities (Min *et al.*, 2001). While, hippadine has been reported to produce reversible inhibition of fertility in male rats (Chattopadhyay *et al.*, 1983). The leaf extract of *Crinum asiaticum* used to treat livers, lumbago, headache and swelling (Ahmed, 1996). Machocho *et al.* (1998) mentioned that *Crinum asiaticum* bulbs have been used to treat caughs, colds, renal and hepatic conditions, sores, sexually and transmitted diseases. Additionally, the aqueous leaf extract of Crinum bulbispermum had antihyperalgesic activity and it appear to result from sedation and antioxidation activities (Ratnasooriya *et al.*, 2005).

The soil is considered a source of many elements continuously supplying the plants with nutritional elements. Some kinds of soil suffer from the dificiency of one or more essential elements, or it may be found in unavailable phase, in this case, such elements could be applied in plant fertilization i.e. foliar application to improve the vegetative growth, as well as, to make better the flowering quality and cropping process.

Micronutrients play a very important role in vital processes of plants. They improve photosynthesis which intensifies the assimilation activity of the whole plants (Marschner, 1995).

Takaki and Kushizake (1978) mentioned that, zinc play an important role in starch and protein synthesis, it is also essential a co-factor in the production of auxins which in turn reflects on the development and growth on the plants treated with it. In addition, its functions are a part co-factor for a lot of enzymes (Amberger, 1991).

The most important function of Mn related to the oxidation-reduction processes (Mengel and Kirkby, 1982). Also, Mukhopadhyay and Sharma (1991) reported that Mn is an essential micronutrient which imported activity in the chloroplast participating in the structure of different photosynthates, proteins and enzymes.

Boron plays a role for increasing the number of chloroplasts per cell (Lipskaya and Fartotskaya, 1971). Gupta (1979) and Tisdale *et al.* (1985) mentioned that boron is considered an essential element for plant growth. It is an important element in carbohydrate translocation with effects on transpiration through the control of sugar and starch formation, cell development and elongation, carbohydrate metabolism, amino acids formation, and the synthesis of proteins.

Foliar fertilization is widely used to provide nutrients or to correct a specific nutrient deficiency. Nutrient foliar applications significantly increased production of citronella plants (Singh *et al.*, 1976 and Chatterjee *et al.*, (1984).

El-Sherbeny and Abou Zeid (1986) found that the growth as well as volatile oil and carbohydrate synthesis of fennel plants were increased by microelements foliar fertilizers containing Cu, Zn, B and Mn.. On *Ammi visnaga*, the application of Mn and Zn at 25 and 50 ppm increased sugar, non soluble carbohydrates and some microelements. (Mazhar, 1988).. The application of zinc at 100 ppm was effective on increasing the flower qualities and carotene percentage of *Calendula officinalis* (Wahabe 1993).

The objective of the present work was to study the influence of foliar application with some micro-elements on growth, flowering, bulb characters and chemical composition of *Crinum asiaticum*, Thumb plants.

MATERIALS AND METHODS

Two experiments work were carried out at the Experimental Farm of Ornamental Plants, Faculty of Agriculture at Moshtohor, Benha University, during two successive seasons of 2004 and 2005 to study the effect of foliar application with two levels of zinc (100 and 200 ppm) combined with manganese at rates of 100, 150 and 200 ppm or Boron at rates of 50, 75 and 100 ppm on the growth, flowering, bulb characters and chemical composition of *Crinum asiaticum* plants.

Cultivation:

Bulbs of *Crinum asiaticum*, Thumb (average weight 175 $\pm$ 5g. and about 6-7 cm. diameter,) were individually planted in the first week of March in both seasons in plots (one m^2). Every plot contained 6 bulbs (planted in hills at 50 x 30 cm). All plants were fertilized with ammonium sulphate (20.5% N), calcium superphosphate (15.5% P_2O_5) and potassium sulphate (48.5% K_2O) at the rates of 150, 200 and 150 kg/fed., respectively. Ammonium sulphate was applied in two split doses after four and seven weeks from planting. However calcium superphosphate and potassium sulphate were applied before planting. After planting soil was directly irrigated to provide suitable moisture for sprouting. Common cultural practices for growing Crinum plants were followed as recommended.

The experiment was layed out in a split plot design with three replicates for each treatment (three plots/treatment).

This experiment included the following treatments:

Zinc element concentrations occupied the main plots (A) and those of manganese or boron elements concentrations were allocated at random in the sub plots (B). Zinc concentrations were sprayed after 30, 40 and 50 days from planting, respectively. While each of manganese and Boron concentrations were sprayed on the plants after 35, 45, and 55 days from planting, respectively. The plants were sprayed till run off. The spraying treatments were carried out at the early of morning and spreading agent "Misrol" was added to solutions (1 ml/L) to reduce solution surface tention. The control plants were sprayed with distilled water.

The following data were recorded:

Number of leaves/plant, fresh and dry weights of leaves (gm)/plant, fresh and dry weights of flowering stalk (gm), number of flowers/flowering stalks, flowering stalk length (cm), flowering stalk diameter (cm), number of days to full blooming, number of flowers/flowering stalk, first flower diameter, fresh weight of flowers (gm) and flower vase life (days). At the end of the experiment (October 25th for both seasons) the following data were recorded number of offsets/plant, diameter of the bulb (cm) and fresh and dry weights of the bulbs (gm).

Chemical analysis of plant:

Leaves from the middle part of the plant and Crinum bulb samples were taken and then dried at 70 °C for 72 hours, finely ground and chemically analyzed at the end of experiment to determine the following constituents:

Total alkaloids percentage in the dry leaves and bulbs were determined according to Fahmy *et al.* (1960).

Total carbohydrates percentage in the dry leaves and bulbs were determined according to Herbert *et al.* (1971).

Total nitrogen, phosphorus and potassium percentages in the dry leaves and bulbs were determined according to Wilde *et al.* (1985).

Statistical analysis:

The results averages of the two growing seasons were statistically analyzed according to the procedure of Snedecor and Cochran (1989). The L.S.D test was used to compare the mean values..

Mechanical and chemical analysis of the experimental soil were estimated according to Jackson (1973) and Blake *et al.* (1982), respectively as shown in Tables (A and B).

Table (A): Mechanical analysis:

Coarse sand	Find sand %	Silt %	Clay %	Organic matter %	E.C m.mhos/cm
7.43%	15.0%	34.88%	40.92%	1.5%	1.64

Table (B): Chemical analysis:

pH	mg/100 gm soil								
	HCO_3	CL^-	So_4^-	Ca^{++}	Mg^{++}	Na^+	K^+	P^+	N^+
7.89	1.99	1.42	0.67	1.28	0.70	1.70	0.31	20.0	82.51

RESULTS AND DISCUSSION

I- Effect of foliar application with zinc, manganese and born on plant growth:

1- Leaves characters:

Data reported in Table (1) show that plants sprayed with Zn alone or in combination with Mn or B increased significantly number of leaves/plant of *Crinum asiaticum* over control plants. The increase in sprayed level of Zn or Mn up to 200 ppm and B up to 100 ppm resulted in the maximum increase of leaves number. The maximum increase was obtained with Zn combined with Mn at the high concentrations (200 ppm) followed by using Zn combined with B at the highest concentrations 200 ppm and 100 ppm, respectively. The increasing percentages over control untreated plant resulted from foliar application of the two micronutrients (Mn + Zn) reached 43.87 and 37.87% in the first and second seasons, respectively, while the rates of increase resulted from the foliar application of B + Zn were 40 and 25.75% for the first and second seasons, respectively.

Thus it may be deduced that the increase of leaves number with spraying Zn, Mn and B alone or in combination would offer further evidence of the effect of micronutrients on increasing cell division.

The results agreed with that obtained by Attoa (2002) on tuberose.

Data listed in the same Table (1) showed that fresh and dry weights of leaves of Crinum plants treated with micronutrients exceeded those of the control. All concentrations of micronutrients increased the fresh and dry weights of leaves/plant compared to control plants. Spraying Mn and B alone or in combination with Zn increased significantly leaves fresh weight of *Crinum asiaticum* plants. In comparison with control untreated plant the rates of increase resulted from application of Mn + Zn at the highest levels were 97.8 and 77.1% of fresh and dry weight of leaves per plant for first season, respectively. In the second season, the rates of increase reached to 104.2 and 77.8% of leaves fresh and dry weight, respectively. Furthermore, the recorded increases in mean values of these fresh and dry weights as a result of spraying with the higher levels (200 ppm) of Zn or/and B (100 ppm) were statistically significant in most cases as compared with unsprayed plants in both seasons. The increase of leaves fresh and dry weights resulted from application 200 ppm of Zn combined with B at the level (100 ppm) were 87.7 and 76.4%, respectively for the first season while the

rates of increase reached 90.6 and 69.4% for the second season, respectively. These increases in the total fresh and dry weights could be attributed to the indirect role of micronutrients in chlorophyll formation. Similar results were reported by El-Sherbeny (1990) on fenugreek. El-Sherbeny and Hussein (1991) on coriander. Gamal El-Din, *et al.* (1997), Refaat and Balbaa (2001) on lemongrass, Alphonse and Saad (2000) on cucumber, El-Shabasi (2001) on garlic, Eid et al. (2002) on Fenugreek and El-Etr and Osman (2005) on corn. They observed the improving effects of Zn, Mn and B as foliar application on vegetative growth..

2- Flowering stalk characters:

Although the length of the flowering stalk shows significant differences as a result of micronutrients application, data in Table (2) show that the longest flowering stalk resulted from spraying the two elements Mn + Zn together.

Foliar application of B or Mn individually at the high concentration or in combination with zinc at the tested concentrations showed increases in flowering stalk length during the two seasons. The longest flowering stalk resulted from spraying Mn + Zn together at the high concentration (200ppm).

Concerning the effect of micronutrients on total fresh and dry weights of flowering stalk / Crinum plant, micronutrient treatments had significant effect son total fresh and dry weights of flowering stalk, as plants sprayed with Mn, Zn or B were heavier than those unsprayed plants. However, applying Mn or B combined with Zn produced higher weights of fresh and dry flowering stalk than those unsprayed plants. In this respect, Tisdale *et al.*, (1985) mentioned that boron is considered an essential element for plant growth, it is an important element in cell development and elongation, carbohydrate metabolism, amino acid formation and the synthesis of proteins. These results confirmed by many other investigators Wahabe (1993) on *Calendula officinalis* and Gomaa, (2001) on *Antholyza aethiopica* plant.

3- Flowering characters:

a- Number of days to full blooming and flower vase life:-

The data in Table (3) showed that all concentrations of micronutrients succeeded in improving flowering parameters i.e., number of days to full blooming and flower vase life.

Regarding number of days to full blooming data in the Table (3) indicated that all applied concentrations of different elements succeeded in decreasing the number of days to full blooming in two seasons as compared to control. Increasing the concentration of nutrient elements up to 200 ppm of Zn and Mn and B up to 100 ppm gave the lowest number of days to full blooming in the two seasons, when compared with control. The highest reduction in number of days to full blooming were obtained by spraying plants with Mn at the high concentration combined with Zn at the same concentration followed by the foliar application of B at the concentration of 100 ppm combined with Zn at the high concentration of 200ppm in both seasons. These results are in agreement with those obtained by Gomaa (2001) on *Antholyza aethiopica*.

Table (1): Effect of foliar application with zinc, manganese and boron on leaves parameters of *Crinum asiaticum*, Thumb plant during 2004 and 2005 seasons.

Zinc levels (ppm) (A) / Mn. and B levels (ppm) (B)	Number of leaves/plant				Fresh weight of leaves/plant (gm)				Dry weight of leaves/plant (gm)			
	0.0	100	200	Mean	0.0	100	200	Mean	0.0	100	200	Mean
	First season (2004)											
Control	11.3	14.3	15.5	13.70	206.5	265.0	281.5	251.0	17.5	21.0	22.5	20.3
Mn at 100	15.7	16.7	17.3	16.57	272.0	293.0	311.0	292.0	23.5	24.5	26.0	24.7
Mn at 150	18.0	18.5	19.0	18.50	286.5	317.5	345.0	316.3	24.0	26.5	28.5	26.3
Mn at 200	19.7	21.5	22.3	21.17	303.0	378.0	408.5	363.2	25.5	28.0	31.0	28.2
B at 50	14.3	15.3	16.5	15.37	251.5	286.5	295.0	277.7	20.5	22.0	25.0	22.5
B at 75	17.5	18.0	19.7	18.40	277.0	311.5	360.5	316.3	21.5	24.5	29.0	25.0
B at 100	18.0	20.3	21.7	20.00	298.5	350.5	385.5	344.8	23.5	25.5	30.0	26.3
Mean	16.36	17.80	18.86		270.7	314.6	341.0		22.3	24.6	27.4	
L.S.D. at	5%		1%		5%		1%		5%		1%	
Main plot (A)	0.36		0.54		10.5		21.73		0.69		0.92	
Sub plot (B)	1.45		1.83		12.4		16.12		1.27		1.96	
Interaction A x B	2.41		2.81		15.8		18.15		1.93		2.82	
	Second season (2005)											
Control	12.5	15.7	16.7	14.97	213.0	277.0	305.5	265.2	18.0	22.0	23.0	21.0
Mn at 100	16.5	17.3	19.0	17.60	288.0	298.5	341.0	309.2	24.0	25.0	28.5	25.8
Mn at 150	18.7	19.7	21.3	19.90	305.0	314.5	372.0	330.2	26.0	27.0	29.5	27.5
Mn at 200	20.0	22.5	23.0	21.83	312.5	387.0	435.0	378.2	26.5	29.5	32.0	29.3
B at 50	15.7	16.3	17.0	16.33	274.0	293.0	326.0	297.7	23.0	24.0	27.0	24.7
B at 75	18.0	18.5	19.7	18.73	290.0	312.5	361.0	321.2	24.0	25.5	28.5	26.0
B at 100	19.5	20.7	21.0	20.40	301.5	360.0	406.0	355.8	26.0	27.0	30.5	27.8
Mean	17.27	18.67	19.67		283.4	320.4	363.8		23.9	25.7	28.4	
L.S.D. at	5%		1%		5%		1%		5%		1%	
Main plot (A)	0.23		0.39		11.03		13.11		1.13		1.28	
Sub plot (B)	1.32		1.78		13.82		16.53		1.41		1.82	
Interaction A x B	2.46		2.87		15.64		18.27		2.36		2.90	

Table (2): Effect of foliar application with zinc, manganese and boron on flowering stalk parameters of *Crinum asiaticum*, Thumb plant during 2004 and 2005 seasons.

Zinc levels (ppm) (A) / Mn. and B levels (ppm) (B)	Fresh weight of flowering stalk/plant (gm)				Dry weight of flowering stalk/plant (gm)				Number of flowering stalk/plant				Length of flowering stalk (cm)				Diameter of flowering stalk (cm)			
	0.0	100	200	Mean	0.0	100	200	Mean	0.0	100	200	Mean	0.0	100	200	Mean	0.0	100	200	Mean
First season (2004)																				
Control	40.0	51.8	54.6	48.8	2.65	3.75	3.80	3.40	1.33	2.33	2.50	2.05	45.3	50.8	52.7	49.6	1.55	1.70	1.85	1.70
Mn at 100	53.5	55.4	57.8	55.6	3.70	3.95	4.05	3.90	2.00	2.50	2.67	2.39	51.3	53.3	55.3	53.3	1.80	1.86	1.96	1.87
Mn at 150	55.7	58.6	63.2	59.2	3.90	4.20	4.30	4.13	2.67	2.67	3.00	2.78	53.5	55.4	58.9	55.9	1.85	1.93	2.00	1.93
Mn at 200	58.2	63.7	65.7	62.5	4.15	4.30	4.55	4.33	2.75	3.00	3.50	3.08	54.6	57.8	61.5	58.0	1.92	2.10	2.25	2.09
B at 50	52.1	54.9	56.2	54.4	3.50	3.60	3.85	3.65	1.50	1.75	2.00	1.75	50.5	52.6	53.7	52.3	1.70	1.85	1.90	1.82
B at 75	55.0	57.5	58.8	57.1	3.90	4.10	4.10	4.03	1.75	2.25	2.67	2.22	52.4	54.2	56.4	54.3	1.75	1.90	1.95	1.87
B at 100	57.3	59.7	62.7	59.9	4.05	4.15	4.20	4.13	2.00	2.50	3.00	2.50	53.6	56.0	58.8	56.1	1.85	1.95	2.15	1.98
Mean	45.1	56.8	59.0	3.69	4.01	4.12			2.00	2.43	2.76		51.6	54.3	56.8		1.77	1.90	2.00	
L.S.D. at	5%		1%		5%		1%		5%		1%		5%		1%		5%		1%	
Main plot (A)	2.3		3.1		0.32		0.58		N.S		N.S		1.21		1.54		N.S		N.S	
Sub plot (B)	2.76		3.65		0.47		0.59		N.S		N.S		2.08		2.47		N.S		N.S	
Interaction A x B	3.81		4.74		0.77		1.03		N.S		N.S		3.14		3.62		N.S		N.S	
Second season (2005)																				
Control	44.0	57.2	58.0	53.1	2.85	3.70	3.90	3.48	1.80	2.00	2.25	2.02	47.0	53.7	55.6	52.1	1.60	1.85	1.95	1.80
Mn at 100	56.1	59.0	59.7	58.3	3.50	3.85	3.90	3.75	2.25	2.33	2.50	2.36	54.2	55.9	58.4	56.2	1.85	1.95	2.10	1.97
Mn at 150	59.3	61.7	63.4	61.5	3.70	4.20	4.10	4.00	2.50	2.67	3.00	2.72	55.3	57.4	62.5	58.4	1.95	2.05	2.15	2.05
Mn at 200	60.2	63.9	66.6	63.6	3.75	4.45	4.65	4.28	2.67	2.75	3.75	3.06	57.1	61.6	63.7	60.8	2.00	2.30	2.45	2.25
B at 50	54.4	58.1	59.3	57.3	3.40	3.60	3.85	3.62	2.00	2.25	2.33	2.19	52.6	53.9	54.5	53.7	1.75	1.80	2.05	1.87
B at 75	57.8	60.5	62.0	60.1	3.60	3.65	4.00	3.75	2.33	2.50	2.75	2.53	53.3	55.0	57.8	55.4	1.85	1.95	2.15	1.98
B at 100	58.4	62.3	64.2	61.6	3.65	3.95	4.20	3.93	2.50	2.67	3.33	2.83	55.6	58.2	60.3	58.0	1.90	2.10	2.25	2.08
Mean	55.7	60.4	61.9		3.49	3.91	4.09		2.29	2.45	2.84		53.6	56.5	59.0		1.84	2.00	2.20	
L.S.D. at	5%		1%		5%		1%		5%		1%		5%		1%		5%		1%	
Main plot (A)	2.17		2.82		0.46		0.72		N.S		N.S		1.26		1.67		N.S		N.S	
Sub plot (B)	2.87		3.23		0.51		0.87		N.S		N.S		1.95		2.43		N.S		N.S	
Interaction A x B	3.78		4.92		0.93		1.14		N.S		N.S		3.06		3.54		N.S		N.S	

Table (3): Effect of foliar application with zinc, manganese and boron on flowering parameters of *Crinum asiaticum*, Thumb plant during 2004 and 2005 seasons.

Zinc levels (ppm) (A) / Mn. and B levels (ppm) (B)	Number of days to full blooming				Number of flowers/flowering stalk				Flower diameter (cm)				Fresh weight of flowers/ flowering stalk (gm)				Flower vase life (days)			
	0.0	100	200	Mean	0.0	100	200	Mean	0.0	100	200	Mean	0.0	100	200	Mean	0.0	100	200	Mean
	First season (2004)																			
Control	108.5	86.0	82.0	92.2	5.5	7.5	8.5	7.2	6.6	9.1	9.8	8.5	15.5	21.0	23.0	19.8	8.0	12.0	12.7	10.9
Mn at 100	100.5	79.0	77.0	85.5	8.0	8.5	9.0	8.5	9.8	10.3	10.6	10.2	23.0	24.0	24.5	23.8	12.3	13.0	13.7	13.0
Mn at 150	96.5	74.0	71.5	80.7	8.5	9.0	9.5	9.0	10.1	10.8	11.3	10.7	23.5	25.0	25.5	24.7	13.7	13.7	14.0	13.8
Mn at 200	94.5	71.0	70.0	78.5	9.0	9.5	10.5	9.7	10.4	11.2	11.5	11.0	24.0	25.5	28.0	25.8	14.3	15.0	15.3	14.9
B at 50	101.0	80.0	78.0	86.3	6.5	7.5	8.5	7.5	8.7	9.4	10.2	9.4	16.5	19.5	21.5	19.2	11.7	12.0	13.0	12.2
B at 75	98.0	76.0	72.5	82.2	7.5	8.0	9.0	8.2	9.5	9.8	10.9	10.1	20.0	20.5	22.0	20.8	12.0	12.3	13.5	12.6
B at 100	96.5	73.0	72.0	80.7	8.0	9.0	9.5	8.8	10.2	10.7	11.2	10.7	22.0	23.5	25.0	23.5	12.3	13.0	13.7	13.0
Mean	99.3	77.1	74.7		7.6	8.4	9.2		9.3	10.2	10.8		20.6	22.7	24.2		12.0	13.0	13.7	
L.S.D. at	5%		1%		5%		1%		5%		1%		5%		1%		5%		1%	
Main plot (A)	3.11		3.75		N.S		N.S		0.13		0.24		0.28		0.41		N.S		N.S	
Sub plot (B)	3.82		4.37		N.S		N.S		0.25		0.37		0.37		0.53		N.S		N.S	
Interaction A x B	4.61		5.18		N.S		N.S		0.33		0.42		0.52		0.78		N.S		N.S	
	Second season (2005)																			
Control	107.0	85.0	81.5	91.2	6.0	8.0	8.5	7.5	6.9	8.9	10.2	8.7	16.0	24.5	25.5	22.0	8.3	12.5	12.7	11.2
Mn at 100	100.5	78.0	75.0	84.5	7.5	8.5	9.5	8.5	9.7	10.3	10.7	10.2	22.5	25.0	27.0	24.8	11.7	12.7	13.0	12.5
Mn at 150	95.0	73.5	71.0	79.8	8.0	9.0	9.5	8.8	10.2	10.7	11.0	10.6	24.5	26.0	28.5	26.3	12.3	13.7	14.7	13.6
Mn at 200	94.0	90.0	68.5	77.7	8.5	9.0	10.5	9.4	10.5	11.1	11.6	11.1	26.0	27.5	29.5	27.7	13.0	14.3	15.3	14.2
B at 50	102.0	79.5	76.5	96.0	7.0	7.5	8.5	7.7	9.1	9.5	9.7	9.4	18.5	20.5	22.0	20.3	11.3	12.7	13.0	12.3
B at 75	97.5	75.0	73.0	81.8	8.5	8.5	9.0	8.7	9.9	10.0	10.5	10.1	23.5	24.0	26.5	24.7	12.0	13.0	13.5	12.8
B at 100	96.0	73.0	71.0	80.0	8.5	9.0	9.0	8.8	10.0	10.5	11.3	10.6	24.5	25.0	26.5	25.3	12.3	13.3	13.7	13.1
Mean	98.9	76.3	73.8		7.7	8.5	9.2		9.5	10.1	10.7		22.2	24.6	26.5		11.6	13.2	13.7	
L.S.D. at	5%		1%		5%		1%		5%		1%		5%		1%		5%		1%	
Main plot (A)	3.08		3.67		N.S		N.S		0.17		0.26		0.32		0.48		0.13		0.27	
Sub plot (B)	3.72		4.26		N.S		N.S		0.22		0.36		0.45		0.62		0.38		0.59	
Interaction A x B	4..42		5.03		N.S		N.S		0.31		0.41		0.58		0.87		0.61		0.93	

Concerning flower vase life, Table (3) showed that micronutrients improved this character over control. Spraying Mn or/and Zn elements increased flower vase life over control in the second season. The increase in sprayed level of Mn or Zn up to 200 ppm resulted in the maximum increase of flower vase life. Similar trends of results were observed by Ahmed (2000) on some annual plants.

b- Number, diameter and fresh weight of flowers/flowering stalk:

Regarding the number, diameter and fresh and dry weights of flowers/ flowering stalk, data obtained during two seasons as shown in Table (3) decleared that all applied concentrations of micronutrients increased the above mentioned parameters of *Crinum asiaticum* flowers in both seasons comparing with untreated plants. The most promising effect was noticed with plants treated by Mn + Zn at the highest concentrations (200 ppm) followed in a descending order by B + Zn at the highest rates of 100 ppm and 200 ppm, respectively.

Generally, increasing of the flower parameters of Crinum as a result of foliar application of micronutrients is in accordance with the results obtained by Attoa (2002). He reported that using Zn at the rate 150 ppm increased the flower diameter and had the superiority values on the other flowering parameters of tuberose plants. Also, these results indicated an increase in yield by micronutrients foliar application supported the findings of other workers as Gupta and Raj (1980) and El-Sherbeny and Hussein (1991) on *Coriandrum sativum*.

4- Bulb characters:

The obtained results in Table (4) cleared that all applyed concentrations of micronutrients i.e. Mn, Zn and B succeeded in increasing bulb parameters i.e. number, diameter, fresh and dry weights of bulbs/plant in both seasons when compared with control plants. Data in the same Table (4) showed that increasing the concentrations of Zn, Mn and B increased the above mentioned bulb parameters. Highly significant differences were obtained between control and Mn + Zn treatment at the highest concentrations of each (200 ppm), followed in descending order by B + Zn at the highest concentration 100 ppm and 200 ppm, respectively. Such as trend was true during both seasons. Similar results were observed by El-Shabasi (2001) on garlic and Gomaa (2001) on *Antholyza aethiopica.*

II- Effect of foliar application with zinc, manganese and boron on chemical composition:

1- Total alkaloid percentage in leaves and bulbs:

Data given in Table (5) showed that spraying *Crinum asiaticum* plants with Zn, Mn or B alone or in combination at all concentrations increased total alkaloids content in leaves and bulbs especially with increasing concentration. The highest values of total alkaloids in leaves and bulbs were obtained with Zn + Mn at the highest levels (200ppm). These increases reached in leaves and bulbs 135.7 and 129.3% over control, respectively followed by using 200 ppm Zn combined with B at the level of 100 ppm. These increases reached in leaves and bulbs 121.4 and 91.9% over control, respectively.

Table (4): Effect of foliar application with zinc, manganese and boron on bulb parameters of *Crinum asiaticum*, Thumb plant during 2004 and 2005 seasons.

Zinc levels (ppm) (A) / Mn. and B levels (ppm) (B)	Number of offsets /plant				Diameter of bulb				Fresh weight of bulbs/plant (gm)				Dry weight of bulbs/plant (gm)			
	0.0	100	200	Mean	0.0	100	200	Mean	0.0	100	200	Mean	0.0	100	200	Mean
	First season (2004)															
Control	1.67	2.00	2.00	1.89	6.25	6.42	6.53	6.40	415.5	465.0	482.0	454.2	50.8	55.7	59.5	55.3
Mn at 100	2.33	2.67	2.67	2.56	7.18	7.50	7.61	7.43	632.0	718.5	770.0	723.5	89.5	93.4	102.6	95.2
Mn at 150	2.33	3.00	3.33	2.89	7.46	7.87	7.89	7.74	730.5	763.5	797.0	763.7	96.5	100.5	105.3	100.8
Mn at 200	2.67	3.33	3.67	3.22	7.82	7.95	8.45	7.97	772.0	792.0	810.0	791.3	101.7	102.8	108.7	104.4
B at 50	2.00	2.33	2.67	2.33	7.05	7.30	7.55	7.30	680.5	703.5	720.5	701.5	87.4	91.8	94.6	91.3
B at 75	2.33	2.67	3.00	2.67	7.21	7.61	7.72	7.51	710.5	760.0	767.0	745.8	92.8	98.9	101.4	97.7
B at 100	2.33	3.00	3.33	2.89	7.67	7.73	7.85	7.75	771.0	780.5	793.0	781.5	97.6	98.9	105.3	100.6
Mean	2.24	2.71	2.95		7.23	7.48	7.61		680.9	712.4	734.7		88.3	91.9	97.1	
L.S.D. at	5%		1%		5%		1%		5%		1%		5%		1%	
Main plot (A)	0.07		0.11		N.S		N.S		1.72		2.08		0.35		0.43	
Sub plot (B)	0.21		0.28		0.23		0.35		2.61		3.43		0.56		0.79	
Interaction A x B	0.31		0.43		0.37		0.51		4.10		4.82		1.09		1.32	
	Second season (2005)															
Control	1.33	2.33	2.33	2.11	6.38	6.65	6.92	6.65	427.0	481.5	506.5	471.7	53.5	58.9	64.6	59.0
Mn at 100	2.00	2.67	3.33	2.33	6.91	7.18	7.65	7.26	703.5	722.0	761.5	929.0	93.0	94.3	101.5	96.3
Mn at 150	2.67	3.00	3.67	3.11	7.40	7.67	7.96	7.68	742.0	781.0	788.5	970.5	95.7	100.0	103.3	99.7
Mn at 200	2.67	3.33	4.00	3.33	7.68	8.10	8.40	8.06	760.5	797.5	809.0	989.0	98.8	101.3	108.5	102.9
B at 50	1.67	2.00	2.67	2.11	6.76	7.08	7.35	7.06	693.0	705.5	751.5	906.7	90.6	92.5	95.9	93.0
B at 75	2.33	3.60	3.00	3.00	7.15	7.33	7.42	7.30	715.5	748.0	762.5	742.0	94.0	96.0	102.0	97.3
B at 100	2.67	3.30	3.67	3.22	7.30	7.50	7.85	7.55	734.5	772.5	790.5	965.8	95.5	99.8	103.7	99.7
Mean	2.24	2.89	3.24		7.09	7.36	7.65		688.9	716.0	734.0		89.0	92.1	97.3	
L.S.D. at	5%		1%		5%		1%		5%		1%		5%		1%	
Main plot (A)	0.08		0.13		N.S		N.S		1.67		2.06		0.37		0.44	
Sub plot (B)	0.25		0.36		0.21		0.33		2.58		3.37		0.62		0.87	
Interaction A x B	0.37		0.46		0.31		0.47		4.02		4.68		1.13		1.44	

Table (5): Effect of foliar application with zinc, manganese and boron on total alkaloids in leaves and bulbs of *Crinum asiaticum*, Thumb plant during (Average of two seasons).

Zinc levels (ppm) / Mn. and B levels (ppm)		Total alkaloids %							
		Leaves				Bulbs			
		0.0	100	200	Mean	0.0	100	200	Mean
Control		0.70	0.89	0.96	0.85	0.99	1.03	1.14	1.05
Manganese	at 50	0.92	0.94	1.16	1.01	1.09	1.18	1.55	1.27
	at 100	0.98	0.99	1.24	1.07	1.25	1.59	1.61	1.48
	at 150	1.11	1.24	1.65	1.33	1.71	1.81	2.27	1.93
Boron	at 50	0.76	0.96	1.25	0.99	1.08	1.11	1.38	1.19
	at 75	0.79	1.29	1.43	1.17	1.13	1.53	1.78	1.48
	at 100	0.94	1.38	1.55	1.29	1.71	1.77	1.90	1.79
Mean		0.82	1.10	1.32	-	1.04	1.43	1.66	-

The highest concentration of Zn, Mn at 200 ppm or B at 100 ppm resulted in the highest alkaloids content in leaves and bulbs comparing with control. Generally, the highest values of total alkaloids content in plant leaves and bulbs of *Crinum asiaticum* were obtained by spraying micronutrients at the highest concentration. These treatments were found to affect the biosynthesis of alkaloid in *Crinum asiaticum*. These results are in agreement with those obtained by Banck (1982) on soybean, Letchamo (1986) on *Digitalis grandiflora*, El-Sherbeny *et al.* (1987) on fenugreek, Mazhar (1988) on *Ammi visnaga*.

2- Total carbohydrates percentage in leaves:

Data in Table (6) indicated that, all foliar spray treatments caused increases in carbohydrate contents in leaves of *Crinum asiaticum*. The highest content in leaves was obtained by using Zn at 200 ppm combined with the high concentrations of Mn or B. In this respect, Shumik *et al.*, 1975 reported that Mo, Co, Mn and B stimulated the biosynthesis and accumulation of green and yellow pigments in blackcurrant leaves. Letchamo (1986) on *Digitalis grandiflora* found that foliar nutrition with sulphates of Mn (0.5%) or Zn (0.02%) increased photosynthetic intensity and chlorophyll content.

Data of the present investigation also showed that leaves content of total carbohydrates for the unsprayed Crinum was 14.3%. It was also found that spraying Crinum with Zn + Mn at the level 200 ppm gave the maximum increase total carbohydrates in leaves followed by the Zn + B foliar spray treatment at the high concentrations in both seasons.

3- Total carbohydrates percentage in bulbs:

It is clear from Table (7) that all treated Crinum plants showed tendency of increase in the contents of total carbohydrates percentage in bulbs for the two seasons as compared to untreated plants. The highest level of Zn + Mn gave the highest content (%) of carbohydrate in bulbs, the increase reached 28.1 and 28.8% over the control plants for the both seasons, respectively. In this connection, Takaki and Kushizaki (1978) mentioned that, zinc play an important role in starch synthesis, it is also essential co-factor in the production of auxins which in turn reflects on the development and growth of the plants treated with it. Gupta (1979) and Tisdale *et al.* (1985) mentioned that boron is considered an important element in carbohydrate metabolism.

Mukhopadhyay and Sharma (1991) reported that Mn is an essential micronutrient imported activity in the chlorophlasts and participating in the structure of different photosynthates and protein enzymes.

The above mentioned results are in agreement with those obtained by Abdalla *et al.* (1983) on *Petrosilinium crispum* Mazhar (1988) on khella, and El-Sherbeny *et al.* (1990) on fenugreek. They reported that micronutrients (Cu, Zn, B and Mn) had a beneficial effect upon the carbohydrates synthesis.

Table (6): Effect of foliar application with zinc, manganese and boron on total carbohydrates, total nitrogen, phosphorous and potassium percentages in leaves of *Crinum asiaticum*, Thumb plant during 2004 and 2005 seasons.

Zinc levels (ppm) / Mn. and B levels (ppm)	Total carbohydrates %				Total nitrogen %				Phosphorus %				Potassium %			
	0.0	100	200	Mean	0.0	100	200	Mean	0.0	100	200	Mean	0.0	100	200	Mean
	First season (2004)															
Control (distilled water)	14.30	16.35	16.70	15.78	2.22	2.56	2.87	2.55	0.23	0.37	0.49	0.36	1.18	1.35	1.47	1.33
Mn at 100	17.72	17.90	18.40	18.01	2.58	2.60	2.65	2.61	0.26	0.41	0.54	0.40	1.27	1.43	1.52	1.41
Mn at 150	18.10	18.75	19.30	18.72	2.61	2.64	2.67	2.64	0.28	0.46	0.56	0.43	1.32	1.44	1.55	1.44
Mn at 200	18.85	19.10	20.20	19.38	2.63	2.65	2.71	2.66	0.32	0.48	0.59	0.46	1.35	1.49	1.59	1.48
B at 50	17.35	17.55	18.00	17.63	2.57	2.58	2.64	2.60	0.27	0.39	0.52	0.39	1.25	1.42	1.53	1.40
B at 75	18.50	18.80	18.85	18.72	2.58	2.62	2.68	2.63	0.29	0.43	0.54	0.42	1.31	1.45	1.54	1.43
B at 100	18.70	19.05	19.50	19.08	2.62	2.63	2.70	2.65	0.31	0.45	0.55	0.44	1.34	1.47	1.58	1.46
Mean	17.79	18.37	18.90		2.56	2.61	2.71		0.28	0.43	0.54		1.29	1.44	1.54	
	Second season (2005)															
Control	15.15	16.85	17.35	16.45	2.05	2.66	2.68	2.46	0.26	0.39	0.51	0.39	1.21	1.37	1.50	1.36
Mn at 100	17.60	17.70	17.90	17.73	2.67	2.70	2.71	2.69	0.31	0.43	0.55	0.43	1.26	1.40	1.54	1.40
Mn at 150	18.30	19.00	19.20	18.83	2.70	2.74	2.76	2.73	0.34	0.45	0.58	0.46	1.28	1.44	1.56	1.43
Mn at 200	18.65	19.40	19.65	19.23	2.73	2.78	2.79	2.77	0.36	0.48	0.60	0.48	1.30	1.46	1.59	1.45
B at 50	17.10	17.50	17.70	17.43	2.65	2.68	2.71	2.68	0.32	0.43	0.53	0.43	1.25	1.38	1.52	1.38
B at 75	18.05	18.30	19.00	18.45	2.67	2.73	2.74	2.71	0.34	0.46	0.57	0.46	1.29	1.43	1.54	1.42
B at 100	18.45	18.80	19.20	18.82	2.71	2.74	2.50	2.65	0.34	0.47	0.59	0.47	1.30	1.45	1.57	1.44
Mean	17.76	18.95	18.71		2.48	2.72	2.70		0.32	0.44	0.56		1.27	1.42	1.55	

Table (7): Effect of foliar application with zinc, manganese and boron on total carbohydrates, total nitrogen, phosphorous and potassium percentages in bulbs of *Crinum asiaticum*, Thumb plant during 2004 and 2005 seasons.

Zinc levels (ppm) / Mn. and B levels (ppm)	Total carbohydrates %				Total nitrogen %				Phosphorus %				Potassium %			
	0.0	100	200	Mean	0.0	100	200	Mean	0.0	100	200	Mean	0.0	100	200	Mean
	First season (2004)															
Control (distilled water)	52.15	58.40	60.70	57.10	1.54	1.67	1.72	1.64	0.36	0.44	0.48	0.43	1.24	1.38	1.43	1.35
Mn at 100	57.60	62.00	63.50	61.00	1.68	1.76	1.80	1.75	0.43	0.50	0.53	0.49	1.37	1.44	1.48	1.43
Mn at 150	59.72	62.50	65.30	62.50	1.72	1.80	1.83	1.78	0.47	0.53	0.57	0.52	1.42	1.50	1.54	1.49
Mn at 200	62.30	65.70	66.80	64.90	1.80	1.85	1.87	1.84	0.52	0.59	0.62	0.58	1.48	1.57	1.58	1.54
B at 50	57.50	61.50	62.40	60.50	1.65	1.71	1.78	1.71	0.42	0.52	0.52	0.49	1.33	1.42	1.44	1.40
B at 75	60.20	63.00	64.90	62.70	1.70	1.78	1.82	1.77	0.45	0.55	0.56	0.52	1.38	1.51	1.50	1.46
B at 100	61.00	65.00	66.00	64.20	1.76	1.83	1.86	1.82	0.49	0.56	0.61	0.55	1.43	1.54	1.56	1.51
Mean	58.6	62.60	64.30		1.69	1.77	1.81		0.49	0.53	0.56		1.38	1.48	1.50	
	Second season (2005)															
Control	53.18	59.20	61.70	58.00	1.55	1.73	1.76	1.68	0.39	0.52	0.49	0.47	1.29	1.37	1.42	1.36
Mn at 100	59.50	62.60	64.30	62.13	1.71	1.78	1.82	1.77	0.48	0.57	0.54	0.53	1.38	1.41	1.48	1.42
Mn at 150	62.20	65.40	66.80	64.80	1.76	1.81	1.85	1.81	0.54	0.62	0.57	0.58	1.43	1.49	1.52	1.47
Mn at 200	64.50	66.90	68.50	66.63	1.81	1.87	1.89	1.86	0.59	0.67	0.64	0.63	1.48	1.50	1.59	1.52
B at 50	59.20	61.70	64.00	61.63	1.68	1.75	1.78	1.74	0.46	0.55	0.53	0.51	1.39	1.39	1.46	1.41
B at 75	62.00	64.30	65.90	64.10	1.73	1.80	1.84	1.79	0.53	0.61	0.59	0.55	1.40	1.49	1.54	1.48
B at 100	63.80	66.50	67.20	65.83	1.75	1.83	1.88	1.82	0.53	0.64	0.62	0.59	1.42	1.49	1.55	1.49
Mean	60.60	63.80	65.50		1.71	1.80	1.83		0.50	0.60	0.57		1.40	1.45	1.51	

4- Mineral elements percentage in leaves and bulbs:

Tables (6 & 7) showed the concentration of macronutrients N, P and K of *Crinum asiaticum* as affected by micronutrients application. It is clear that the different levels of Mn, Zn and B alone or in combination caused pronounced increase in N, P and K % in the leaves and bulbs of *Crinum asiaticum* plant compared to the control treatment. The highest mean value of N, P and K % were obtained with the mixture of Mn + Zn at the high concentrations (200 ppm) in both seasons. These results are in agreement with those obtained by Nassar (2005) on peanut. He mentioned that spraying plants with micronutrients (Fe, Zn, Mn and B) gave the highest minerals, oil and protein contents. Improvement of the nutritive status, in general, of different plant species for strengthening the physiological sink, as revealed by the increase in their nutrient uptake and production which was observed by Sabry *et al.* (1985) on wheat and barley.

It can be concluded from the abovementioned results that all micronutrient sprayed treatment with Zn, Mn and B each alone increased all vegetative growth parameters, flowering characters and bulb production/plant. The mixture of both elements (Mn + Zn) gave the best results for vegetative growth, yield and its components in comparison those with sprayed with Mn or Zn alone.

Accordingly, it might be pointed out that Crinum plant need more nutrients by direct application of both elements Mn and Zn in order to improve the physiological performance. Thus, the nutritive status as well as productivity of Crinum plant could be improved. This is confirmed by Amberger (1974) who indicated that Mn has important functions in plant metabolism, especially in chlorophyll synthesis, photosynthesis, nitrate reduction, amino acids and protein synthesis, activation of different enzymes and finally in photohormones regulation.

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تأثير الرش ببعض العناصر الصغرى على النمو والإزهار والتركيب الكيماوى لنبات الكريزنم

حسناء عبدالحسيب حسن جوده
الهيئة القومية للرقابة والبحوث الدوائية

أجريت تجربتان حقليتان خلال موسمى الزراعة ٢٠٠٤، ٢٠٠٥ بمزرعة التجارب والبحوث الزراعية بكلية الزراعة بمشتهر جامعة بنها وذلك لدراسة تأثير الرش بكل من البورون بتركيزات ٥٠، ٧٥، ١٠٠ جزء فى المليون والمنجنيز بتركيزات ١٠٠، ١٥٠، ٢٠٠ جزء فى المليون والتفاعل مع تركيزات مختلفة من الزنك (صفر، ١٠٠، ٢٠٠ جزء فى المليون) وذلك على النمو والأزهار والمحتوى الكيماوى لنباتات الكريزنم.

هذا وقد تم رش الزنك بعد ٣٠، ٤٠، ٥٠ يوما من الزراعة بينما تم رش كل من المنجنيز والبورون بعد ٣٥، ٤٥، ٥٥ يوما من الزراعة. وكانت أهم النتائج التى تم الحصول عليها هى مايلى:ـ

- أدت جميع المعاملات من الزنك، المنجنيز، البورون والتفاعل بينهم الى زيادة معنوية فى متوسط عدد الأوراق والوزن الطازج والجاف للأوراق لكل نبات وخاصة معاملات التفاعل والتى أعطت أعلى النتائج فى هذا الخصوص.
- أدت معاملات الزنك والمنجنيز والبورون والتفاعل الى التبكير فى أزهار نباتات الكرينم وبفروق عالية المعنوية فى معظم الحالات وتحقق أفضل تبكير فى الأزهار من معاملات التفاعل.
- أدت جميع المعاملات الى زيادة قطر أول زهرة ــ طول الحامل الزهرى ــ قطر الحامل الزهرى عند القاعدة ، عدد الأزهار لكل حامل زهرى، وعدد الحوامل الزهرية لكل نبات وكذلك الوزن الطازج والجاف للحوامل الزهرية وحققت معاملات التفاعل أفضل النتائج وبفروق عالية المعنوية فى معظم القياسات وذلك خلال موسمى التجربة.
- أدت المستويات المختلفة من الزنك ، المنجنيز، البورون وكذلك معاملات التفاعل بينهم الى زيادة طول فترة حياة أزهار نبات الكرينم الزهرية وذلك بالمقارنة بمعاملة الكنترول.
- أعطت التركيزات المتوسطة والمرتفعة من الزنك والمنجنير والبورون زيادة كبيرة فى متوسد عدد الخلفات لكل نبات وحققت معاملات التفاعل أعلى متوسط فى هذا الخصوص.
- أدى التركيز العالى من العناصر المختلفة وكذلك معاملات التفاعل الى زيادة قطر بصلة الكرينم وكذلك الوزن الطازج والجاف للأبصال لكل نبات وذلك بالمقارنة بنباتات الكنترول.
- أدت المستويات المختلفة من الزنك والمنجنيز والبورون وكذلك معاملات التفاعل بينهم الى زيادة النسبة المئوية لكل من النيتروجين ، الفوسفور، البوتاسيوم، الكربوهيدرات الكلية، القلويدات الكلية، فى كل من الأوراق والأبصال وذلك بالمقارنة بنباتات الكنترول.
- عموما يمكن النصح برش نباتات الكرينم بالزنك بتركيز ٢٠٠ جزء فى المليون + المنجنيز ٢٠٠ جزء فى المليون وذلك للحصول على محصول كبير وعالى الجودة من نباتات الكرينم.