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RESPONSE OF CRINUM PLANTS TO FOLIAR APPLICATION WITH GA_3 AND CALCIUM.

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ABSTRACT

Two field experiments were carried out during the two successive seasons of 2006 / 2007 and 2007 / 2008 to investigate the effect of GA_3 (0, 50, 100 and 150 ppm) and calcium (0, 50, 100 and 150 ppm) as well as their interaction on growth, flowering, chemical composition and bulb production of *Crinum asiaticum* plants.

All concentrations of GA_3 or calcium increased leaves parameters (number, width, length and dry weight of leaves / plant), floret parameters (number, diameter and fresh weight of florets / spike) and spike parameters (number, length, diameter and spike fresh weight), as well as, total carbohydrates and number and fresh weight of bulbs / plant.

All concentrations of GA_3 or calcium decreased the number of days to full blooming and extending the duration of flower on plant and flower vase life. Morever, GA_3 at all concentrations decreased whereas calcium concentrations increased the total chlorophylls contents in the leaves.

All combinations between GA_3 and calcium concentrations had a positive effect on growth, flowering and bulb production. And the treatment GA_3× calcium at 150 ppm showed the most beneficial effect in this respect.

INTRODUCTION

Crinum asiaticum plant is one of the most important flowering bulbs of Family Amaryllidaceae. It is attractive perennial flowering herbaceous plant with tunicate, long-necked, ovoid true bulbs, native to tropical and warm temperature regions of both hemispheres.

Crinum is grown successfully in Egypt, mostly outdoors, as a flower bed impact or in borders and as a foliage and flowering pot plant. It is seldom grown indoors because it requires much space. The large showy, pure white, funnel-shapped flowers, and 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 last for 8 – 10 weeks, nearly (Bailey, 1976).

Gibberellic acid and calcium had an effect on plant growth at stages of development and these effects vary according to the kind of plant or tissue. The role of gibberellins has been indicated many years ago. Leopold and Kriedeman (1995) emphasized that GA_3 promotes growth by its effect on cell division and cell enlargement, also it promotes the synthesis of new enzymes associated with stimulation of RNA synthesis. In addition, gibberellin influences many aspects of plant growth and development, it promotes stem elongation, initiates flowering in rosette plants with a long day or cold temperature requirements, replace the cold temperature needed for breaking dormancy or advancing particular stages of development (Johan, 1977 and Lambers *et al.,* 2000).

Sanap *et al.,* (2000) indicated that sprayed tuberose with GA_3 at 150 ppm produced the highest yield of flowers. Abou–Talib and Kandeel (2001) showed that application of GA_3 at 500 ppm as soaking gave the

highest value of length, diameter and fresh weight of flower stalk of *Iris tingitoria*. Salama (2003) on *Strelitzia reginae* found that GA_3 improved all growth and flowering characters.

Concerning calcium, El–Sallami (1996) on *Ficus benjamina* found that addition the nutrient solution such as $CaSo_4$ (1.2 mg / L.) to the media of plants improved growth. Beel *et al.,* (1998) on Spathiphyllum plants concluded that the optimum growth was obtained by using fertilization contained calcium in the nutrient solution as 156 mg / L. Youssef (2000) proved that calcium at 50, 100 and 200 ppm increased number of offsets, leaves and roots of *Strelitzia reginae*. Gomaa (2003) on *Dahlia pinnata* found that all concentrations of calcium (50, 100 and 150 ppm) improved plant height, stem diameter of plant, leaves and flowers parameters as well as chemical composition (total carbohydrates, total chlorophylls, and carotenoids).

The purpose of the present work is to throw light on the effects of gibberellic acid and calcium as well as their interaction on growth, flowering and chemical composition of *Crinum asiaticum* plants.

MATERIALS AND METHODS

Two field experiments were carried out at Experimental Farm of Ornamental plants, Fac. Agric., Minia Univ. during the two seasons of 2006 / 2007 and 2007 / 2008 to study the effect of gibberellic acid and calcium as foliar application on *Crinum asiaticum. L*.

Bulbs of Capa lily plants (average weight was 110 and 112 g and 6 and 7 cm. diameter for the first season and second one, respectively) were individually planted in the first week of March for both seasons in 1 × 1 m plots containing 2 rows, 50 cm apart. Bulbs were planted in hills, 25 cm. apart (4 bulbs / row). Physical and chemical properties of the soil used are listed in Table (A). The split plot design with three replicates was followed.

Table (A) : Physical and chemical properties of the used soil.

Soil properties	Value	Soil properties		Value
Sand %	15.56	Ex. Ca mg / 100 g soil		17.92
Silt %	39.98	Ex. K mg / 100 g soil		2.17
Clay %	44.46	Total N %		0.14
Texture grade	Clay loame	Avail. P ppm.		19.12
Organic matter %	1.51			
$CaCo_3$ %	1.45	DTPA	Fe	8.75
E.C. m mhos / cm	0.67	Ext. ppm	Zn	2.99
pH (1 : 2.5)	8.02		Mn	25.65

In a field trial phosphorus was applied at 20 g / m^2 of calcium superphosphate (15.5% P_2O_5) before planting. While nitrogen at 50 g / m^2 of ammonium nitrate (33.5 % N) and potassium at 20 g / m^2 of potassium sulphate (48 % K_2O) were applied in two split doses (35 and 50 days from planting). Common cultural practices for growing Capa lily plants were followed as recommended in this region.

GA_3 at concentrations of 0.0, 50, 100 and 150 ppm was represented as a main plot and calcium (*Cheleate calcium*) at concentrations of 0.0, 50, 100 and 150 ppm as sub plots. Each of GA_3 and calcium were applied as a foliar spray (GA_3 in early morning, while calcium afternoon) three times at 2 weeks interval starting from one month after planting. Control plants were sprayed with distilled water.

Sampling measurements and determinations :

The following data were recorded :

Number, width, length and dry weight of leaves / plant. Number of days to start flowering, number, diameter and fresh weight of florets / spike, duration of flower, flower vase life. Number, length, diameter and fresh weight of spikes. Total chlorophylls and carbohydrates. Number and fresh weight of bulbs / plant.

Chemical analysis of plant :

Chlorophylls were determined in the fresh leaves according to A.O.A.C. (1980).

Total carbohydrates content in dry leaves were determined according to Smith *et al.,* (1959). All samples of chemical analysis were taken at the flowering start.

All the obtained data were subjected to the statistical analysis of variance using MSTAT–C (1986). L.S.D. test at 0.05 was used to compare the average means of treatments.

RESULTS AND DISCUSSION

Effect of foliar application with gibberellic acid and calcium:

1- Leaves parameters :

Data in Tables (1 and 2) showed that all treatments were positively effective in increasing the leaves parameters of *Crinum asiaticum* i.e. number, width, length and dry weight of leaves / plant during the two seasons.

Data in Tables (1 and 2) indicated that all concentrations of GA_3 significantly increased leaves parameters when compared with control in both seasons. Moreover, increasing GA_3 concentrations up to 150 ppm produced the best results of the measured parameters of crinum leaves in both seasons. Similar results were obtained by Gomaa (1997) on narcissus plants and Nagaraja *et al.,* (1999) on tuberose plants.

Regarding the effect of calcium on leaves parameters, data in Tables (1 and 2) showed that all concentrations of calcium significantly improved leaves parameters in comparison with control in both seasons. The best results of leaves parameters of crinum were obtained by using the highest concentration of calcium (150 ppm). These results are coincided with the findings by Youssef (2000) on *Strelitzia reginae*.

The interaction between GA_3 and calcium treatments was significant in the two seasons for leaves parameters of crinum. The best interaction treatments were obtained by using GA_3 at 150 ppm and calcium at 150 ppm (Tables, 1 and 2).

Table (1) : Effect of gibberellic acid and calcium on number of leaves / plant, width of leaves / plant and length of leaves / plant of *Crinum aziaticum* plant during 2006 / 2007 and 2007 / 2008 seasons.

	Gibberellic acid concentrations ppm									
	1st season					2nd season				
	0.0	50	100	150	Mean	0.0	50	100	150	Mean
Number of leaves / plant (cm)										
Control	15.1	16.0	17.5	18.1	16.68	16.00	17.3	18.7	19.3	17.83
Calcium at 50 ppm	15.7	16.8	18.3	19.0	17.45	16.5	17.9	19.4	20.1	18.48
Calcium at 100 ppm	16.2	17.5	19.0	19.8	18.13	16.9	18.4	20.0	20.8	19.03
Calcium at 150 ppm	16.6	18.1	19.6	20.5	18.70	17.2	18.8	20.5	21.4	19.48
Mean	15.90	17.10	18.60	19.35		16.65	18.10	19.65	20.4	
L.S.D. 5 %	A: 0.75	B: 0.34			AB: 0.68	A: 0.73	B: 0.29			AB: 0.58
Width of leaves / plant (cm)										
Control	4.60	4.80	5.10	5.30	4.95	4.80	5.00	5.20	5.33	5.08
Calcium at 50 ppm	4.79	5.00	5.32	5.55	5.17	5.01	5.22	5.41	5.55	5.30
Calcium at 100 ppm	5.06	5.28	5.41	5.58	5.33	5.17	5.30	5.48	5.61	5.39
Calcium at 150 ppm	5.36	5.46	5.51	5.62	5.48	5.40	5.51	5.59	5.67	5.45
Mean	4.95	5.14	5.34	5.51		5.10	5.26	5.42	5.54	
L.S.D. 5 %	A: 0.17	B: 0.02			AB: 0.04	A: 0.11	B: 0.03			AB: 0.06
Length of leaves / plant (cm)										
Control	55.1	60.0	64.2	67.4	61.68	57.4	63.3	68.4	72.0	65.28
Calcium at 50 ppm	57.3	63.2	68.4	72.3	65.30	58.5	64.7	69.8	74.0	66.75
Calcium at 100 ppm	58.8	64.9	69.9	74.1	66.93	59.4	65.9	71.4	75.9	68.15
Calcium at 150 ppm	60.2	66.8	71.6	75.5	68.53	61.3	68.3	74.2	79.1	70.73
Mean	57.85	63.73	68.53	72.33		59.15	65.55	70.95	75.25	
L.S.D. 5 %	A: 3.11	B: 1.55			AB: 3.10	A: 3.56	B: 1.60			AB: 3.20

2- Number, diameter and fresh weight of florets / spike :

Referring to number, diameter and fresh weight of florets / spike data obtained during the two seasons as shown in Tables (2 and 3) declared that all tested concentrations of GA_3 significantly increased the above-mentioned parameters of *Crinum asiaticum* florets in both seasons comparing with untreated plants. Meanwhile, the most promising effect was noticed with plants treated by the highest concentration of GA_3 (150 ppm) followed by GA_3 at 100 ppm and diameter for number of florets / spike. These results go in line with those reported by Gomaa (1997) on narcissus plants; Sanap *et al.,* (2000) on tuberose plants and Abou–Talib and Kandeel (2001) on *Iris tingitana* bulbs.

Data in Tables (2 and 3) demonstrates that calcium treatments induced significant effect on number, diameter and florets fresh weight, so calcium at 150 ppm gave the hig54hest values in this respect. Gomaa (2003) proved that calcium treatments influenced number, diameter and flower fresh weight of dahlia plant.

The interactions between the concentrations of GA_3 and calcium were significant for number, diameter and fresh weight of florets in both seasons. It is quite clear that the interaction between GA_3 and calcium at concentration of 150 ppm is being the mos effective one on number, diameter and fresh weight of florets / spike of *Crinum asiaticum*.

3- Number of days to full blooming, duration and flower vase life :

Data in Table (2) showed that all applied concentrations of GA_3 succeeded in decreasing the number of days to full blooming in both seasons as compared to control. Increasing the concentrations of GA_3 up to 150 ppm gave the lowest number of days to full blooming in the two seasons growing when compared with control. These results are in agreement with those obtained by Leena *et al.,* (1992) on gladiolus plants and Shi *et al.,* (1997) on freesia corms. Meanwhile, data in Tables (3 and 4) revealed that all concentrations of GA_3 significantly succeeded in extending the duration of flower (on plant) and flower vase life in the first and second seasons as compared with control. GA_3 at 150 ppm showed the highest values for improving the duration of flower (on plant) and flower vase life. Similar results were obtained by Gomaa (1997) on narcissus plants and Gomaa (2003) on dahlia plants.

Table (2): Effect of gibberellic acid and calcium on dry weight of leaves / plant (gm), number of days to full blooming and number of florets / spike of *Crinum aziaticum* plant during 2006 / 2007 and 2007 / 2008 seasons.

	Gibberellic acid concentrations ppm									
	1st season					2nd season				
	0.0	50	100	150	Mean	0.0	50	100	150	Mean
Dry weight of leaves / plant (gm)										
Control	18.12	19.23	21.17	21.54	20.02	19.52	21.45	22.46	23.19	21.66
Calcium at 50 ppm	18.85	20.33	21.96	22.78	20.98	20.46	22.20	24.01	24.71	22.85
Calcium at 100 ppm	19.44	21.35	22.81	23.74	21.84	20.92	22.85	24.82	25.59	23.55
Calcium at 150 ppm	20.59	22.08	23.52	24.40	22.65	21.36	23.33	25.48	26.34	24.13
Mean	19.25	20.75	22.37	23.12		20.57	22.46	24.19	24.96	
L.S.D. 5 %	A: 0.74		B: 0.33		AB: 0.66	A: 0.75		B: 0.37		AB: 0.74
Number of days to full blooming										
Control	88.67	84.25	82.1	81.01	84.01	84.33	82.11	80.00	79.01	81.36
Calcium at 50 ppm	85.96	83.71	81.56	80.11	82.84	80.63	78.34	76.18	75.02	77.54
Calcium at 100 ppm	84.23	82.36	80.12	79.16	81.47	79.45	77.31	75.21	74.11	76.52
Calcium at 150 ppm	83.00	81.12	79.0	77.83	80.24	78.50	76.42	74.38	73.02	75.58
Mean	85.57	82.86	80.70	79.53		80.73	78.55	76.44	75.29	
L.S.D. 5 %	A: 2.1		B: 0.54		AB: 1.08	A: 1.89		B: 0.49		AB: 0.98
Number of florets / inflorescence										
Control	8.00	8.64	8.96	9.60	8.80	8.33	8.63	9.55	9.85	9.09
Calcium at 50 ppm	8.96	9.59	10.22	10.26	9.76	9.22	9.83	10.24	10.84	10.03
Calcium at 100 ppm	9.56	10.19	10.41	10.43	10.15	9.83	10.75	11.03	11.64	10.81
Calcium at 150 ppm	10.18	11.24	11.56	11.89	11.22	10.44	11.41	11.72	12.35	11.48
Mean	9.18	9.92	10.29	10.55		9.46	10.16	10.64	11.17	
L.S.D. 5 %	A: 0.62		B: 0.15		AB: 0.30	A: 0.52		B: 0.31		AB: 0.62

Table (3) : Effect of gibberellic acid and calcium on diameter of floret / spike (cm), fresh weight of florets / spike (g) and duration of flower (days) of *Crinum aziaticum* plant during 2006 / 2007 and 2007 / 2008 seasons.

	Gibberellic acid concentrations ppm									
	1st season					2nd season				
	0.0	50	100	150	Mean	0.0	50	100	150	Mean
Diameter of floret / inflorescence (cm)										
Control	5.85	6.14	6.32	6.45	6.19	6.35	6.65	6.93	7.07	6.75
Calcium at 50 ppm	6.20	6.57	6.77	6.83	6.59	6.61	6.86	7.01	7.11	6.90
Calcium at 100 ppm	6.32	6.69	6.90	6.97	6.72	6.80	7.01	7.15	7.22	7.05
Calcium at 150 ppm	6.81	7.11	7.28	7.39	7.15	7.21	7.35	7.51	7.75	7.46
Mean	6.30	6.63	6.82	6.91		6.74	6.97	7.15	7.29	
L.S.D. 5 %	A: 0.26		B: 0.06		AB: 0.12	A: 0.30		B: 0.12		AB: 0.24
Fresh weight of florets / inflorescence (g)										
Control	22.18	23.27	23.95	24.45	23.46	23.43	24.41	25.29	25.66	24.70
Calcium at 50 ppm	24.12	25.56	26.13	26.18	25.50	25.05	25.71	26.15	26.50	25.85
Calcium at 100 ppm	25.03	26.49	27.19	27.20	26.48	26.25	26.91	27.31	27.43	26.98
Calcium at 150 ppm	27.18	28.14	28.61	28.61	28.19	28.05	28.38	28.95	29.68	28.76
Mean	24.63	25.87	26.47	26.66		25.70	26.35	26.93	27.32	
L.S.D. 5 %	A: 0.19		B: 0.10		AB: 0.20	A: 0.38		B: 0.31		AB: 0.62
Duration of flower (days)										
Control	21.34	21.85	22.15	23.35	22.17	22.13	22.65	23.15	24.25	23.05
Calcium at 50 ppm	21.60	21.85	22.65	23.65	22.44	22.90	23.50	24.50	24.85	23.94
Calcium at 100 ppm	22.85	23.35	24.40	25.00	23.90	23.40	24.50	25.0	25.25	24.53
Calcium at 150 ppm	24.15	25.0	26.50	27.15	25.70	24.15	25.50	26.25	28.95	26.21
Mean	22.49	23.01	23.93	24.79		23.15	24.04	24.73	25.83	
L.S.D. 5 %	A: 0.82		B: 0.32		AB: 0.64	A: 0.95		B: 1.10		AB: 2.20

Concerning number of days to full blooming, it is obvious that the three concentrations of calcium succeeded in reducing the number of days to full blooming in both seasons as compared with control. Moreover, data in Tables (3 and 4) showed that all concentrations of calcium succeeded to enhance the duration of flower (on plant) and flower vase life in both seasons. This was in accordance with the previous results on dahlia plants reported by Gomaa (2003).

The interaction between the concentrations of GA_3 and calcium was significant for number of days to full blooming, duration of flower and flower vase life in both seasons, except for flower vase life in the second season which was insignificant. The best interaction treatment was obtained by using GA_3 × calcium each at 150 ppm each.

Table (4): Effect of gibberellic acid and calcium on flowers vase life (days), number of spike / plant and length of inflorescence / plant of *Crinum aziaticum* plant during 2006 / 2007 and 2007 / 2008 seasons.

	Gibberellic acid concentrations ppm									
	1st season					2nd season				
	0.0	50	100	150	Mean	0.0	50	100	150	Mean
Flowers vase life (days)										
Control	9.33	12.00	13.00	14.00	12.08	9.67	12.50	13.50	14.25	12.48
Calcium at 50 ppm	12.75	12.50	13.00	14.75	13.25	13.00	13.25	14.	14.50	13.69
Calcium at 100 ppm	14.50	14.75	15.50	15.75	15.13	14.75	15.00	15.25	15.50	15.13
Calcium at 150 ppm	12.25	15.75	15.75	16.50	15.81	15.80	16.25	16.50	16.50	16.26
Mean	12.96	13.75	14.31	15.25		13.31	14.25	14.81	15.19	
L.S.D. 5 %	A: 0.84		B: 0.36		AB: 0.72	A: 0.38		B: 0.51		AB: N.S
Number of spike / plant										
Control	2.33	2.33	2.67	3.00	2.58	2.33	2.45	2.45	2.75	2.50
Calcium at 50 ppm	2.33	2.33	2.75	3.15	2.64	2.33	2.33	2.33	3.00	2.50
Calcium at 100 ppm	2.67	3.33	3.00	3.25	3.06	2.67	2.75	3.00	3.75	2.89
Calcium at 150 ppm	3.00	3.45	3.67	3.67	3.45	3.33	3.75	3.75	2.88	3.64
Mean	2.58	2.86	3.02	3.27		2.67	2.82	2.88	3.16	
L.S.D. 5 %	A: 0.26		B: 0.21		AB: N.S	A: 0.14		B: 0.23		AB: N.S
Length of spike / plant (cm)										
Control	40.33	44.33	47.00	49.67	45.33	43.67	48.33	52.00	55.67	49.92
Calcium at 50 ppm	42.00	46.67	49.33	51.33	47.33	46.17	51.67	55.33	58.45	52.91
Calcium at 100 ppm	42.50	47.25	51.36	54.67	48.95	46.92	52.91	57.85	63.75	55.36
Calcium at 150 ppm	43.00	49.00	54.33	53.84	51.50	47.50	54.75	61.50	66.50	57.56
Mean	41.96	46.81	50.51	53.84		46.07	51.92	56.67	61.09	
L.S.D. 5 %	A: 2.75		B: 1.61		AB: 3.22	A: 2.95		B: 1.25		AB: 2.50

4- Inflorescence parameters :

Data in Tables (4 and 5) showed that the three tested concentrations of GA_3 significantly increased inflorescence parameters i.e. number, length, diameter and fresh weight of inflorescence / plant in both seasons compared with control. Also, GA_3 at 150 ppm gave the highest values in this respect. In conformity with these results were those declared by Sanap *et al.,* (2000) on *Iris tingitoria* and Salama (2003) on *Strelitzia reginae*.

Tables (4 and 5) showed that all concentrations of calcium significantly increased number, length, diameter and fresh weight of inflorescence / plant in both seasons, except the concentration of 50 ppm which had no significant effect on number of spike / plant in both seasons. Calcium at 150 ppm gave the highest values for spike parameters. These results are in harmony with those of Beel *et al.,* (1998) on Spathiphyllum plants; Youssef (2000) on *Strelitzia reginae* and Gomaa (2003) on dahlia plants.

5- Total chlorophylls and total carbohydrates :

Data presented in Tables (5 and 6) interpreted that total chlorophylls and total carbohydrates (%) in the leaves were significantly affected by using GA_3 which showed a great decrease in total chlorophylls, while an opposite trend was obtained in total carbohydrates as compared to control. The high concentration of GA_3 at 150 ppm was the most effective

treatment for either increasing leaf total carbohydrates or decreasing total chlorophylls. Referring to calcium treatments, data in Tables (5 and 6) showed that total chlorophylls and total carbohydrates were considerably increased due to application of calcium treatments compared to control plant. All interactions significantly affected total chlorophylls and total carbohydrates content in leaf at both seasons. The highest values of total chlorophylls were obtained due to calcium at 150 ppm without GA_3, while the high concentration of GA_3 (150 ppm) plus calcium 150 ppm gave the highest values of total carbohydrates. These results are close with those obtained by Gomaa (1997) on narcissus plants and Gomaa (2003) on dahlia plants.

Table (5) : Effect of gibberellic acid and calcium on diameter of spike (g), spike fresh weight (g) and total chlorophyll (mg / g. F. wt.) of *Crinum aziaticum* plant during 2006 / 2007 and 2007 / 2008 seasons.

	Gibberellic acid concentrations ppm									
	1st season					2nd season				
	0.0	50	100	150	Mean	0.0	50	100	150	Mean
Diameter of spike (cm)										
Control	1.03	1.17	1.19	1.19	1.15	1.13	1.20	1.23	1.24	1.20
Calcium at 50 ppm	1.27	1.27	1.29	1.30	1.28	1.33	1.36	1.38	1.38	1.36
Calcium at 100 ppm	1.33	1.36	1.36	1.36	1.35	1.44	1.54	1.62	1.63	1.56
Calcium at 150 ppm	1.43	1.55	1.60	1.60	1.55	1.58	1.60	1.64	1.64	1.62
Mean	1.27	1.34	1.36	1.36		1.37	1.43	1.47	1.47	
L.S.D. 5 %	A: 0.02		B: 0.02		AB: 0.04	A: 0.02		B: 0.02		AB: 0.04
Spike fresh weight (g)										
Control	43.60	45.40	46.17	46.25	45.36	44.30	46.56	47.73	48.11	46.68
Calcium at 50 ppm	44.95	47.67	48.18	50.67	47.87	45.36	53.10	53.78	54.25	51.62
Calcium at 100 ppm	46.00	53.18	53.37	54.22	51.69	46.81	60.06	63.18	64.10	58.54
Calcium at 150 ppm	47.51	60.92	63.36	65.18	59.24	48.39	64.80	65.95	67.80	61.74
Mean	45.52	51.79	52.77	5408		46.22	56.13	57.66	58.57	
L.S.D. 5 %	A: 1.21		B: 0.85		AB: 1.70	A: 0.90		B: 0.87		AB: 1.74
Total chlorophyll (mg / g. F. wt.)										
Control	2.956	2.845	2.801	2.730	2.833	2.998	2.875	2.805	2.764	2.861
Calcium at 50 ppm	3.175	3.018	2.910	2.825	2.982	3.225	3.137	3.025	2.960	3.087
Calcium at 100 ppm	3.268	3.157	3.011	2.987	3.106	3.309	3.146	3.068	2.980	3.126
Calcium at 150 ppm	3.375	3.268	3.157	3.019	3.205	3.415	3.299	3.128	3.061	3.226
Mean	3.194	3.072	2.970	2.890		3.237	3.115	3.007	2.941	
L.S.D. 5 %	A: 0.080		B: 0.051		AB: 0.102	A: 0.066		B: 0.052		AB: 0.104

6- Bulb parameters :

Data presented in Table (6) pointed out that GA_3 treatments significantly enhanced number and fresh weight of bulbs / plant in both seasons when compared with control treatment. The highest values of number and fresh weight of bulbs / plant were obtained by using GA_3 at 150 ppm. These results are in agreement with those obtained by Gomaa (2003) on Dahlia plants.

Concerning the effect of calcium treatments on number and fresh weight of bulbs / plant, data in Table (6) showed that all concentrations of calcium significantly enhanced number and fresh weight of bulbs / plant as compared with control in both seasons. Calcium at 150 ppm gave the highest

record of bulb parameters. This finding was similar to those obtained by Gomaa (1997) on narcissus plants; Youssef (2000) on *Strelitzia reginae* and Gomaa (2003) on dahlia plants.

Table (6) : Effect of gibberellic acid and calcium on number of leaves / plant, width of leaves / plant and length of leaves / plant of *Crinum aziaticum* plant during 2006 / 2007 and 2007 / 2008 seasons.

	Gibberellic acid concentrations ppm									
	1st season					2nd season				
	0.0	50	100	150	Mean	0.0	50	100	150	Mean
Total carbohydrates %										
Control	10.65	11.90	12.50	13.00	12.01	12.33	12.85	13.10	13.60	12.97
Calcium at 50 ppm	12.40	14.40	14.75	15.25	14.20	14.08	15.10	16.15	16.35	15.42
Calcium at 100 ppm	13.00	15.25	15.75	16.00	15.00	15.60	16.10	16.85	17.15	16.43
Calcium at 150 ppm	13.75	16.75	16.75	17.00	16.06	17.15	17.45	17.95	18.10	17.66
Mean	12.45	14.58	14.94	15.31		14.79	15.38	16.01	16.30	
L.S.D. 5 %	A: 0.35		B: 0.12		AB: 0.24	A: 0.28		B: 0.07		AB: 0.14
Number of bulbs / plant										
Control	2.33	2.85	3.15	3.40	2.93	2.33	2.67	2.85	3.15	2.75
Calcium at 50 ppm	2.85	3.00	3.33	3.67	3.21	2.70	2.95	3.15	3.33	3.03
Calcium at 100 ppm	3.10	3.35	3.67	3.85	3.49	2.95	3.15	3.35	3.70	3.29
Calcium at 150 ppm	3.45	3.75	3.75	4.00	3.74	3.40	3.67	3.90	4.15	3.78
Mean	2.93	3.24	3.48	3.73		2.85	3.11	3.31	3.58	
L.S.D. 5 %	A: 0.22		B: 0.07		AB: 0.14	A: 0.24		B: 012		AB: 024
Fresh weight of bulbs / plant (g)										
Control	404.6	423.7	438.9	453.4	430.2	399.6	418.5	425.6	448.6	423.1
Calcium at 50 ppm	431.4	450.4	462.7	475.9	455.1	431.8	445.3	458.1	468.7	451.0
Calcium at 100 ppm	456.1	469.8	473.1	489.5	472.1	447.1	458.4	469.3	475.6	462.6
Calcium at 150 ppm	486.2	499.1	510.6	518.3	503.6	481.1	492.6	518.6	522.4	503.7
Mean	444.6	460.8	471.3	484.3		439.9	453.7	467.9	478.8	
L.S.D. 5 %	A: 13.00		B: 3.80		AB: 7.6	A: 10.8		B: 4.6		AB: 9.2

The interaction between GA_3 and calcium treatments was significant for number and fresh weight of bulbs / plant in both seasons as shown in Table (6). It is quite evident that crinum plants treated with the interaction between GA_3 and calcium at concentration of 150 ppm gave the highest values of number and bulbs fresh weight in both seasons.

DISCUSSION

The results of this experiment revealed the promotive effect of GA_3 and calcium on growth and production of flowers and bulbs of crinum plants. These effect could be attributed to that GA_3 promotes growth by its effect on cell division and cell enlargement. Also, GA_3 promotes the synthesis of new enzymes associated with stimulation of RNA synthesis. In addition, gibberellins influence many aspects of plant growth and development (Johan, 1977), the positive effect of calcium may be due to the role of Ca on the division and extension of root cells through since it is required for the incorporation of materials into the cell walls (Lambers *et al.,* 20

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استجابة نباتات الكرينم للرش بالجبرلين والكالسيوم

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معهد بحوث البساتين – مركز البحوث الزراعية – الجيزة

أجريت تجربتان حقليتان خلال موسمى الزراعة ٢٠٠٦ / ٢٠٠٧ و ٢٠٠٧ / ٢٠٠٨ لبحث تأثير الجبرلين (صفر – ٥٠ – ١٠٠ – ١٥٠ جزء / مليون) والكالسيوم (صفر – ٥٠ – ١٠٠ – ١٥٠ جزء / مليون) والتداخل بينهما على النمو والازهار والمحتوى الكيماوى وإنتاج الأبصال .

- أدت كل تركيزات الجبرلين أو الكالسيوم إلى زيادة فى صفات الأوراق (العدد والعرض والطول والوزن الجاف للأوراق للنبات) وصفات الزهيرة (العدد والقطر والوزن الطازج لزهيرات النورة) وصفات النورة (العدد والطول والقطر والوزن الطازج للنورة) بالإضافة إلى المحتوى الكلى للكربوهيدرات وعدد الوزن الطازج للأبصال / نبات .
- أدت كل تركيزات الجبرلين أو الكالسيوم إلى التبكير فى التزهير وإلى زيادة فى عمر الأزهار على النبات وبعد القطف .
- أدت كل معاملات الجبرلين إلى نقص فى الكلوروفيلات الكلية فى الأوراق الطازجة بينما كل معاملات الكالسيوم أدت إلى زيادة فى محتوى الكلوروفيلات الكلية .
- أدت كل معاملات التداخل بين الجبرلين والكالسيوم لكل التركيزات إلى تأثير ايجابي معنوى على النمو والتزهير وإنتاج الأبصال .
- أفضل معاملة تداخل هى بين الجبرلين والكالسيوم عند تركيز ١٥٠ جزء / مليون .