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EFFECT OF BULB SIZE AND CHEMICAL FERTILIZATION ON GROWTH, FLOWERING, BULBS PRODUCTIVITY AND CHEMICAL COMPOSITION OF *Hippeastrum vittatum* PLANT

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ABSTRACT: Two field trials were carried out to study the effect of 12 treatments represented the combination between thee bulb sizes of *Hippeastrum vittatum* (small, medium, and large.) and four rates of NPK chemical composition (0, 2, 4 and 6 g/plant) on the growth, flowering, bulbs productivity and chemical composition of *Hippeastrum vittatum* plant. Results showed that the combination of the large bulb size significantly induced the greatest values of plant height, leaves number and fresh and dry weights, particularly those treated with chemical fertilizer at the highest rate in the two seasons. The earliest flowering was recorded by the combined treatment between large bulb size and chemical fertilizer at 6g/L, followed by the combined treatment between large size and chemical fertilization at 4g/plant in the two seasons. Furthermore, the combination of large bulb size scored the highest values of inflorescence length, inflorescence stem diameter, inflorescence fresh weight and flowering percentage, especially those received chemical fertilization at the high rate in the two seasons. The highest results of bulb and bulblet diameter, bulb fresh and dry weights and number of bulblets / plant were detected with the combinations of large bulb size, especially those received chemical fertilization at the high rate in the two seasons. The highest leaf N, P, K. total carbohydrates and total chlorophylls contents were scored by the combined treatment between large bulb size and chemical fertilization at 6 g/plant in the two seasons. Conclusively, fertilizing *Hippeastrum vittatum* plants with mineral fertilization with N: P: K at 6g/L induced prospective effects on vegetative growth and flowering parameters with higher bulbs productivity.

Key words: *Hippeastrum vittatum*, growth, flowering, chemical constituents and bulbs productivity.

INTRODUCTION

The flowering bulbous plants are considered as a group of the most beautiful adjuncts for garden decoration. They are used particularly in landscape, production of commercial cut-flowers and act as a source of glorious colors and perfumes. *Hippeastrum vittatum*, Herb. cv. Apple Blossom belongs to the Family *Amaryllidaceae*. Apple Blossom has pretty pink bloom with white striping. Very strong grower, large spectacular trumpet shaped. The most popular genus is Hippeastrum, usually called Amaryllis. *Hippeastrum vittatum*, Herb. is categorized as winter flowering ornamental bulbs, monocotyledon, herbaceous plant. It is grown in Egypt for outdoor, as a flower bed impact and in borders, as well as, for cut flowers and indoor, as a pot plant. Amaryllis has no actual rest-period if grown in warm weather as that of Egypt in which it keeps its foliage evergreen all over the year. The inflorescence emerges under Egypt temperature in Mid-April and lasts for a limited short period i.e. 2 -4 weeks (**Everett, 1991**). Flowers are in great demand both in internal and external markets is performed in by many factors, especially use of optimum size of bulbs for planting goes a long way in influencing in the productivity and as well as the quality of the flowers in bulbous crop. The increasing size of plant material with sufficient stored food material which nourished the plant in the later stages of the development may be a reason for progressive increase in the growth of the plant. In bulbous crop, the plant size is proportional to the transplant size (**Manimaran *et al.*, 2017**). In Lily, **Addai and Scott (2011)** reported that 10, 20, 30 g sizes of small bulbs and different sizes of large bulbs of 60, 70, 80 g. Among this, the large bulbs (60-80 g) shows the more leaf width and length, chlorophyll content and also increases in inflorescence length, inflorescence

height, inflorescence diameter and inflorescence quality. **Abdulhabip and Erden (2018)** on *Narcissus tazetta* subsp. Tazetta, mentioned that the bulb size with 12-14 cm was found to be suitable for cut flower production and the bulb sizes with 10-12 cm and lower size were suitable for bulb production and landscaped areas.

Most bulbs need more than two applications of fertilizers during the growing season, but the most important point is that the greatest increase in size and weight of the new developing bulb takes place in the period during and mostly after flowering, as long as the foliage remains in good condition. Thus, fertilization must continue for good vegetative growth to produce a good flower and large new mature bulbs (**Rees, 1992**). In this concern, **El-Malt *et al.* (2006)** indicated that treating *Hippeastrum vittatum* plants with chemical fertilizer (NPK) at 5 g/pot improved the vegetative and flowering growth. Moreover, **Youssef and Abdel al (2014)** revealed that fertilized *Hippeastrum vittatum* with mineral fertilization at 6g/plant gave the maximum beneficial effect on the vegetative growth characteristics, flowering, bulb and bulblets production. Thereupon, this study was undertaken to evaluate the effect of bulb size and mineral fertilization (NPK) on growth, flowering, bulbs productivity and chemical composition of *Hippeastrum vittatum* plant.

MATERIALS AND METHODS

This study was carried out in the open field at the Floriculture Nursery of the Horticulture Department Faculty of Agriculture at Moshtohor, Benha University, during 2018/2019 and 2019/2020 seasons to study the effect of bulb size (small, medium and large) and some NPK chemical fertilization treatments (0, 2, 4 and 6 g/plant) in combining treatments to lump their benefits in vegetative growth, flowering, bulb production and chemical composition of *Hippeastrum vittatum* plants.

Plant material

The used bulbs of *Hippeastrum vittatum*, "local variety" were classified into three sizes i.e., large size (7-8 cm diameter with the weight of 175-189 g), medium size (5-5.5cm diameter with the weight of 120-130 g) and small size (3.5-4 cm with the weight of 75-82 g). The bulbs were obtained freshly from Floriculture Nursery of the Horticulture Department, Faculty of Agriculture at Moshtohor, Benha University.

Planting procedure

Bulbs of *Hippeastrum vittatum* were planted in loamy soil "(the analyses of the used soil are presented in Tables (a, b)" on mid-October in beds 1x1m^2 as every bed contain 4 bulbs planted at 50x50 cm in between in both seasons.

Table a. Mechanical analysis of the experimental soil

Parameters	Unit	Seasons	
		2018/2019	2019/2020
Coarse sand	%	5.13	4.86
Fine sand	%	14.74	15.12
Silt	%	27.18	26.31
Clay	%	52.95	53.71
Textural class	---	Loamy	Loamy

Table b. Chemical analysis of the experimental soil

Parameters	Unit	Seasons	
		2018/2019	2019/2020
$CaCo_3$	%	1.04	1.11
Organic matter	%	1.52	1.59
Available nitrogen	%	0.81	0.86
Available phosphorus	%	0.34	0.39
Available potassium	%	0.74	0.78
E.C	ds/m	1.08	1.12
pH	---	7.71	7.78

Fertilization treatments

All planting sizes (small, medium and large) of *Hippeastrum vittatum* bulbs received chemical fertilizer (using ammonium nitrate (33% N), calcium superphosphate (15.5% P_2O_5) and potassium sulfate (48% K_2O). A mixture of the three fertilizers, with a ratio of 1:1:1 (N: P_2O_5: K_2O), was prepared and applied to the plants at the rate of 2, 4 and 6g/plant (8, 16 and 24 g/ plot) as side dressing eight times at monthly interval, starting at mid-January in the two seasons.

Experiment layout

The design of this experiment was factorial experiments in a complete randomize block design with 12 treatments represented the combinations between three bulb sizes i.e., small, medium and large and chemical fertilization at the rates of 0, 2, 4 and 6 g/ plants (3 bulb sizes x 4 chemical fertilization rates) replicated three times (each replicate consisted of five beds, with four plants/bed). Common agricultural practices (irrigation, manual weed control, … etc.) were carried out when needed.

Recorded data

1- Vegetative growth parameters: Plant height, number of leaves, leaves fresh weight and leaves dry weight.

2- Flowering growth parameters: Flowering start (number of days from planting time to show color of the first flower), inflorescence length, flowering stem diameter and inflorescence fresh weight.

3- Bulb growth parameters: Bulb diameter, fresh and dry weight of bulb, number and diameter of bulblets.

4- Chemical composition measurements: At the flowering stage the chemical composition measurements were recorded:

- Total nitrogen: Total nitrogen was measured in sample solutions by using the modified micro-kjeldahl method as described by **Pregl (1945).**

- Phosphorus content: Phosphorus was determined colourimetrically in spectronic (20) spectrophotometer using the method described by **Trouge and Meyer (1939).**

- Potassium content: Potassium content was measured by flamephotometer according to **Brown and Lilleland (1946).**

- Total carbohydrates content: Total carbohydrates content was determined in dry powder material according to **Herbert *et al.* (1971).**

- Total chlorophylls contents: Total **chlorophylls** content (mg/100g f.w.) was determined in fresh leaves according to **AOAC (1990).**

Statistical analysis

All data obtained in both seasons of study were subjected to analysis of variance as factorial experiments in a complete randomize block design. L.S.D. method was used to differentiate between means according to **Snedecor and Cochran (1989).**

RESULTS AND DISCUSSION

Vegetative growth parameters

Data in Tables (1 and 2) cleared that the increases in vegetative growth parameters of *Hippeastrum vittatum* plants are linearly increased with the increment of bulb size, so the tallest plants and the highest number of leaves as well as the heaviest fresh and dry weights of leaves were recorded by using the largest bulb size, followed in descending order by using the medium size in the two seasons. The differences between the abovementioned two treatments were significant in most cases in the two seasons. The small bulb size scored the lowest values in this concern in the two seasons. Respecting the effect of chemical fertilization treatments, data in Tables (1and 2) revealed that the highest values of plant height, leaves number and fresh and dry weights were gained by using the high rate (6g/plant), followed in descending order by the medium rate (4g/plant) in the two seasons. Furthermore, chemical fertilizer at the low rate (2 g/plant) gave high increments in this concern in the two seasons. On the opposite, the lowest values of these parameters were gained by un-fertilized plants in the two seasons. Referring to the interaction effect between bulb size and chemical fertilizer data in Tables (1and 2) show that the combination of the large bulb size significantly induced the greatest values of plant height, leaves number and fresh and dry weights, particularly those treated with chemical fertilizer at the highest rate in the two seasons. On the contrast, the lowest values were scored by planting small bulb size and received no chemical fertilization in the two seasons. The remained treatments occupied an intermediate position between the aforementioned treatments in the two seasons.

The stimulated effect of chemical fertilization may be due to the role of chemical fertilization on supplying the plants with their required nutrients for more carbohydrates and proteins production which are necessary for vegetative growth of *Hippeastrum vittatum* plants **(Marschner, 1995).**

The results of chemical fertilization are in parallel with those obtained by **Manoly (1996)** on Iris, **Shahin (1998)** on *Hemerocallis aurantiaca***,** mentioned that spraying the plants with greenzit (foliar fertilizer containing macro and micro elements) at the rates of 1, 3 or 5cm^3 per liter increased the number of leaves and offshoots /plant and fresh and dry weights of leaves, **Atta-lla and Zaghloul (2002)** on Iris, **Youssef and Goma (2007)** on *Iris tingitana* and **Abou-El-Ella (2007)** showed that spraying *Acanthus mollis* plants with Kristalon at 2, 3 or 4 g/L and New-star fertilizer at 3, 4 or 5 g/L increased plant height, number of leaves and fresh and dry weights of the leaves, **Taha (2012)** fertilizing iris plant with commercial foliar fertilizers (namely Singral, Allgrow and Manfret "B", each at 0.05, 0.1 and 0.2 %) enhanced plant height, number of leaves, fresh and dry weights of leaves, especially the high level (0.2%), **Youssef and Abd El-Aal (2014)** revealed that fertilizing *Hippeastrum vittatum* plants with chemical fertilizer (NPK) at 6 g/plant improved the tested vegetative growth parameters i.e., plant height, number of leaves, fresh and dry weights of leaves, **Ghatas (2015)** reported that fertilizing *Hemerocallis aurantiaca* plants with NPK chemical fertilizer at 3 and 5 g/plant increased plant height, number of leaves and offshoots, fresh and dry weights of leaves and **Seyedeh *et al.*, (2015)** fertilizing narcissus (*Narcissus tazetta*) plant with potassium nitrate (KNO_3) at 2 or 4g/plant enhanced plant height, number of leaves, fresh and dry weights of leaves, especially the high level. **Abou El-Ghait et al., (2020)** cleared that fertilizing jasmine plants with NPK mineral fertilizer at 6 g/pot, induced prospective effects on vegetative growth with higher quality of this plant.

Table 1. Effect of bulb size and chemical fertilization on plant height and number of leaves of *Hippeastrum vittatum* plant during 2019 and 2020 seasons

Bulb size(a) / Fertiliz. (b)	plant height (cm)				number of leaves/plant			
	Small	Medium	Large	Mean	Small	Medium	Large	Mean
1st season								
0	28.6	31.2	34.6	31.5	5.82	6.48	8.13	6.81
2g/plant	31.6	34.4	38.2	34.7	6.24	7.39	9.38	7.67
4g/plant	35.2	38.2	43.6	39	7.36	8.24	11.28	8.96
6g/plant	36.4	39.8	45.1	40.4	9.24	11.04	12.62	11.0
Mean	33.0	35.9	40.4		7.17	8.29	10.4	
L.S.D at 0.05	a=1.24	b =1.43	a*b= 2.47		a=0.81	b =0.93	a*b= 1.61	
2nd season								
0	26.4	32.6	36.2	31.7	6.08	7.36	8.64	7.36
2g/plant	29.2	36.8	39.8	35.3	7.82	8.92	10.13	8.96
4g/plant	32.0	29.2	44.0	38.4	8.64	9.84	11.30	9.93
6g/plant	34.9	41.0	46.8	40.9	9.64	11.14	12.18	10.99
Mean	30.6	37.4	41.7		8.05	9.32	10.56	
L.S.D at 0.05	a=1.32	b =1.52	a*b= 2.63		a=0.84	b =0.97	a*b= 1.67	

Table 2. Effect of bulb size and chemical fertilization on leaves fresh and dry weights of *Hippeastrum vittatum* plant during 2019 and 2020 seasons

Bulb size(a) / Fertiliz. (b)	leaves fresh weight (g)				leaves dry weight (g)			
	Small	Medium	Large	Mean	Small	Medium	Large	Mean
1st season								
0	41.2	57.6	97.2	65.3	4.92	7.13	12.64	8.23
2g/plant	43.4	65.7	111.6	73.6	5.19	8.21	14.51	9.30
4g/plant	51.1	73.8	134.4	86.4	6.12	9.23	17.48	10.94
6g/plant	64.4	101.2	151.2	105.6	7.68	12.6	19.66	13.31
Mean	50.0	74.6	123.6		5.98	9.29	16.1	
L.S.D at 0.05	a=8.24	b =9.48	a*b= 16.39		a=1.14	b =1.31	a*b= 2.27	
2nd season								
0	48.3	80.3	111.8	80.1	5.76	10.51	14.51	10.26
2g/plant	62.4	97.8	113.3	91.2	7.46	12.28	17.11	12.28
4g/plant	68.8	96.8	146.9	104.2	8.21	12.17	19.14	13.17
6g/plant	76.8	122.1	157.3	118.7	9.14	15.23	20.52	14.96
Mean	64.1	99.3	132.3		7.64	12.55	17.82	
L.S.D at 0.05	a=12.1	b =13.9	a*b= 24.1		a=1.72	b =1.98	a*b= 3.42	

Flowering growth measurements

Data in Tables (3 and 4) showed that the number of days to start flowering was decreased as the size of bulb increased in the two seasons. Hence, using large bulb size significantly induced earlier flowering after 208 and 205 days, followed by medium size which recorded 218and 224 days as compared with 225 and 233 days for planting small size in the first and second seasons, respectively. Moreover, inflorescence length, inflorescence stem diameter, inflorescence fresh weight and flowering percentage were greatly increased with increasing bulb size in the two seasons. In addition, all rates of chemical fertilizer resulted in early flowering and high values in inflorescence length, inflorescence stem diameter, inflorescence fresh weight and flowering percentage of *Hippeastrum vittatum*, plant, especially the high rate (6 g/ plant), followed by the medium rate in the two seasons.

On the other hand, all combinations between bulb size and chemical fertilization levels induced a remarkable precocity in flowering start, especially the combinations of large bulb size in both seasons. In this regard, the earliest flowering was recorded by the combined treatment between large bulb size and chemical fertilizer at 6g/L, followed by the combined treatment between large size and chemical fertilization at 4g/plant in the two seasons. Furthermore, the combination of large bulb size scored the highest values of inflorescence length, inflorescence stem diameter, inflorescence fresh weight and flowering percentage, especially those received chemical fertilization at the high rate in the two seasons. On the reverse, the highest flowering delaying as well as the lowest values of inflorescence length, inflorescence stem diameter, inflorescence fresh weight and flowering percentage were recorded by the combined treatments between small bulb size and received no chemical fertilization in the two seasons. The stimulated effect of chemical fertilization may be due to the role of chemical fertilization on supplying the plants with their required nutrients for more carbohydrates and proteins production which are necessary for flowering growth of *Hippeastrum vittatum* plants **(Marschner, 1995).**

The aforementioned results of chemical fertilization are coincided with those obtained by **Barman and Pal (1993)** on *Polianthes tuberosa*, **Mukherjee *et al.* (1994)** on gladiolus, **Singh and Uma (1996)** on *Polianthes tuberosa*, **Shahin (1998)** on *Hemerocallis aurantiaca*, showed that spraying the plants with greenzit (foliar fertilizer containing macro and micro elements) at the rates of 1, 3 or 5cm^3 per liter improved flowering start, number of flowers, length and diameter of flower stalk, fresh and dry weights of flower and flower vase life, **Youssef (2004)** stated that treating *Strelitzia reginae* plants with stimufol fertilizer at 4 or 6 g/L enhancing flowering growth parameters i.e., number of days to start flowering "flowering date", length of flowering stalk, diameter of flowering stalk fresh and dry weights of flowering stalk, **Taha (2012)** fertilizing iris plant with commercial foliar fertilizers (namely Singral, Allgrow and Manfret "B", each at 0.05, 0.1 and 0.2 %) enhanced flowering start, length, diameter of flowering length, fresh and dry weights of flower, especially the high level (0.2%), **Seyedeh *et al.* (2015)** fertilizing narcissus (*Narcissus tazetta*) plant with potassium nitrate (KNO_3) at 2 or 4g/plant improved flowering start, length, diameter of flowering length, fresh and dry weights of flower, especially the high level (0.2%), **Youssef and Abd El-Aal (2014)** revealed that fertilizing *Hippeastrum vittatum* plants with chemical fertilizer (NPK) at 6 g/plant improved the tested flowering growth parameters i.e., flowering start, length, diameter of flowering length, fresh and dry weights of flower and **Ghatas (2015)** pointed out that fertilizing *Hemerocallis aurantiaca* plants with NPK chemical fertilizer at 3 and 5 g/plant accelerated flowering start, increased flower number, length and diameter of flowering length, fresh and dry weights of flower. **Abou El-Ghait *et al.* (2020)** cleared that fertilizing jasmine plants with NPK mineral fertilizer at 6 g/pot, induced prospective effects on flowering parameters with higher quality of this plant.

Table 3. Effect of bulb size and chemical fertilization on flowering start and inflorescence length of *Hippeastrum vittatum* plant during 2019 and 2020 seasons

Bulb size(a) / Fertiliz. (b)	Flowering start (days)				Inflorescence length (cm)			
	Small	Medium	Large	Mean	Small	Medium	Large	Mean
1st season								
0	231	224	212	222	31.4	36.2	41.8	36.5
2g/plant	227	218	208	218	32.6	38.9	42.7	38.1
4g/plant	221	216	207	215	34.7	41.2	46	40.6
6g/plant	219	213	204	212	35.1	41.8	48.2	41.7
Mean	225	218	208		33.5	39.5	44.7	
L.S.D at 0.05	a=5.15	b =5.92	a*b= 10.2		a=2.32	b =2.67	a*b= 4.62	
2nd season								
0	238	229	209	225	29.8	34.8	39.9	34.8
2g/plant	234	226	206	222	31.4	36.7	42.1	36.7
4g/plant	231	221	203	218	32.8	39.1	43.2	38.4
6g/plant	228	220	201	216	33.7	39.8	45.1	39.5
Mean	233	224	205		31.9	37.6	42.6	
L.S.D at 0.05	a=6.24	b =7.18	a*b= 12.41		a=4.27	b =4.91	a*b= 8.49	

Table 4. Effect of bulb size and chemical fertilization on inflorescence stem diameter, inflorescence fresh weight and flowering (%) of *Hippeastrum vittatum* plant during 2019 and 2020 seasons

Bulb size(a) / Fertiliz.(b)	Inflorescence stem diameter (cm)				Inflorescence fresh weight (g)				Flowering (%)			
	Small	Medium	Large	Mean	Small	Medium	Large	Mean	Small	Medium	Large	Mean
1st season												
0	1.18	1.45	1.62	1.42	118.2	138.4	162.4	139.6	21.6	64.8	92.8	59.7
2g/plant	1.24	1.48	1.69	1.47	121.8	141.6	168.3	143.9	24.8	69.3	98.9	64.3
4g/plant	1.31	1.53	1.82	1.55	128.4	148.2	176.4	151.0	36.2	76.2	100	70.8
6g/plant	1.37	1.59	1.89	1.62	131	151.3	181.3	154.5	39.4	78.3	100	72.6
Mean	1.28	1.51	1.76		124.9	144.9	172.1		30.5	72.2	97.9	
L.S.D at 0.05	a=0.14	b =0.16	a*b= 0.28		a=8.2	b =9.43	a*b= 16.3		a=7.7	b =8.85	a*b= 13.31	
2nd season												
0	1.21	1.41	1.59	1.4	106.4	132.9	165.3	134.9	24.3	61.7	94.6	60.2
2g/plant	1.26	1.48	1.64	1.46	112.6	136.8	171.3	140.2	26.8	66.9	97.8	63.8
4g/plant	1.36	1.56	1.73	1.55	119.3	141	179.2	146.5	34.1	74.3	100	69.5
6g/plant	1.39	1.57	1.8	1.59	121.7	143.6	185.6	150.03	36.2	75.8	100	70.7
Mean	1.31	1.51	1.69		115	138.6	175.4		30.4	69.7	98.1	
L.S.D at 0.05	a=6.24	b =7.18	a*b= 12.41		a=6.24	b =7.18	a*b= 12.41		a=6.24	b =7.18	a*b= 12.41	

Bulb growth parameters

The data obtained in Tables (5 and 6) on bulb parameters show that all tested bulb sizes statistically affected the values of bulb parameters of *Hippeastrum vittatum* plants in both seasons. In this concern, the highest values of bulb diameter, bulb fresh and dry weights and number and diameter of bulblets / plant were achieved by using large bulb size, followed by using medium bulb size in the two seasons. The lowest values were gained by using the small bulbs in the two seasons.

With studying the effect of chemical fertilizer data in Table (5 and 6) clear that the highest values of bulb diameter, bulb fresh and dry weights and number and diameter of bulblets / plant were registered by chemical fertilizer at the high rate, followed by the medium rate in the two seasons in the two seasons. On the reverse, the lowest values of these parameters were obtained by un-fertilized plants in the two seasons.

Respecting the interaction effect between bulb sizes and chemical fertilizer, data in the same Tables refer that the highest results of bulb and bulblet diameter, bulb fresh and dry weights and number of bulblets / plant were detected with the combinations of large bulb size, especially those received chemical fertilization at the high rate in the two seasons. On the opposite, the lowest values of these parameters were gained by planting small bulbs, particularly those received no chemical fertilization in the two seasons. The stimulated effect of chemical fertilization may be due to the role of chemical fertilization on supplying the plants with their required nutrients for more carbohydrates and proteins production which are necessary for bulb growth of *Hippeastrum vittatum* plants **(Marschner, 1995).**

The obtained results of chemical fertilization are coincided with those obtained by **Barman and Pal (1993)** on *Polianthes tuberosa*, **Mukherjee *et al.* (1994)** on gladiolus, **Singh and Uma (1996)** on *Polianthes tuberosa*, **Shahin (1998)** on *Hemerocallis aurantiaca*, mentioned that spraying the plants with greenzit (foliar fertilizer containing macro and micro elements) at the rates of 1, 3 or 5cm^3 per liter enhanced all studied bulb parameters, **Youssef (2004)** cleared that fertilizing *Strelitzia reginae* plants with stimufol fertilizer at 4 or 6 g/L improved root growth parameters i.e., number of roots, length of root and fresh and dry weights of roots, **Taha (2012)** fertilizing iris plant with commercial foliar fertilizers (namely Singral, Allgrow and Manfret "B", each at 0.05, 0.1 and 0.2 %) increased bulb number, fresh and dry weights of bulbs, especially the high rate (0.2%), **Seyedeh *et al.* (2015)** fertilizing narcissus (*Narcissus tazetta*) plant with potassium nitrate (KNO_3) at 2 or 4g/plant improved bulb number, fresh and dry weights of bulb, especially the high level (0.2%), **Youssef and Abd El-Aal (2014)** indicated that fertilizing *Hippeastrum vittatum* plants with chemical fertilizer (NPK) at 6 g/plant improved the tested bulb growth parameters i.e., bulb diameter, bulb fresh and dry weights and number and diameter of bulblets / plant and **Ghatas (2015)** revealed that fertilizing *Hemerocallis aurantiaca* plants with NPK chemical fertilizer at 3 and 5 g/plant improved bulb diameter, bulb fresh and dry weights and number and diameter of bulblets / plant.

Table 5. Effect of bulb size and chemical fertilization on bulb fresh and dry weights of *Hippeastrum vittatum* plant during 2019 and 2020 seasons

Bulb size(a) / Fertiliz.(b)	Bulb fresh weight (g)				Bulb dry weight (g)			
	Small	Medium	Large	Mean	Small	Medium	Large	Mean
1st season								
0	69.4	114.5	168.2	117.4	11.73	20.24	30.42	20.8
2g/plant	78.6	119.3	176	124.6	13.26	21.13	31.81	22.07
4g/plant	89.4	126	189.4	134.9	15.13	22.6	34.2	23.98
6g/plant	92.7	129.5	194.3	138.8	15.64	23.12	34.98	24.58
Mean	82.5	122.3	182		13.94	21.77	32.85	
L.S.D at 0.05	a=8.16	b =9.38	a*b= 16.2		a=2.18	b =2.51	a*b= 4.34	
2nd season								
0	65.3	108.3	164.3	112.6	14.04	19.54	31.16	21.58
2g/plant	72.1	114.9	173.3	120.1	12.69	21.42	32.87	25.33
4g/plant	82.9	120.5	184.7	129.4	14.76	21.7	34.96	23.81
6g/plant	86.4	124	189.5	133.3	15.48	22.36	35.91	24.58
Mean	76.7	116.9	178		14.24	21.26	33.73	
L.S.D at 0.05	a=8.27	b =9.51	a*b= 16.45		a=3.37	b =3.88	a*b= 6.70	

Table 6. Effect of bulb size and chemical fertilization on number of bulbs, diameter of bulb and diameter of bulblet of *Hippeastrum vittatum* plant during 2019and 2020 seasons

Bulb size(a) / Fertiliz.(b)	Number of bulbs				Diameter of bulb (cm)				Diameter of bulblet (cm)			
	Small	Medium	Large	Mean	Small	Medium	Large	Mean	Small	Medium	Large	Mean
1st season												
0	3.24	4.17	6.28	4.56	3.86	5.62	7.24	5.57	2.14	2.43	2.64	2.4
2g/plant	3.61	4.36	6.52	4.83	3.92	5.84	7.36	5.71	2.18	2.51	2.68	2.46
4g/plant	3.94	5.08	7.82	5.61	4.26	6.27	8.14	6.22	2.26	2.58	2.76	2.53
6g/plant	4.02	5.14	8.46	5.87	4.61	6.54	8.26	6.47	2.31	2.61	2.84	2.59
Mean	3.70	4.69	7.27		4.16	6.07	7.75		2.22	2.53	2.73	
L.S.D at 0.05	a=0.46	b =0.53	a*b= 0.92		a=0.37	b =0.43	a*b= 0.74		a=0.10	b =0.11	a*b= 0.19	
2nd season												
0	3.18	4.21	6.17	4.52	3.92	5.51	7.18	5.54	2.18	2.41	2.59	2.6
2g/plant	3.54	4.51	6.62	4.89	4.08	5.91	7.29	5.76	2.21	2.48	2.67	2.45
4g/plant	3.82	4.92	6.94	5.23	4.39	6.31	8.04	6.25	2.29	2.56	2.84	2.56
6g/plant	3.97	5.04	7.32	5.44	4.76	6.6	8.17	6.51	2.33	2.59	2.92	2.61
Mean	3.63	4.67	6.76		4.29	6.08	7.67		2.25	2.51	2.76	
L.S.D at 0.05	a=0.27	b =0.31	a*b= 0.54		a=0.29	b =0.33	a*b=0.58		a=0.11	b =0.12	a*b= 0.20	

Chemical composition determination

Data tabulated in Table (7 and 8) indicated that leaf chemical composition of *Hippeastrum vittatum* plant was greatly affected by using all tested bulb sizes in both seasons. In this concern, the richest leaf N, P, K total carbohydrates and total chlorophylls contents were recorded by planting the large bulb, followed in descending order by using the medium size in the two seasons. The lowest leaf N, P, K. total carbohydrates and total chlorophylls were scored by using the small size. Besides, all studied chemical fertilization rates gave high increments in this concern, especially the high rate, followed by the

medium rate in the two seasons. The differences between the aforementioned two treatments were not significant in most cases in the two seasons. Furthermore, all interactions between bulb size and chemical fertilization rates increased leaf N, P, K. total carbohydrates and total chlorophylls contents in both seasons. However, the highest leaf N, P, K. total carbohydrates and total chlorophylls contents were scored by the combined treatment between large bulb size and chemical fertilization at 6 g/plant in the two seasons.

On contrary, the lowest values of leaf chemical composition parameters were scored by un-fertilized small bulbs, followed in ascending order by the combined treatment between small bulb and received chemical fertilization at 2g/plant in the two seasons.

The stimulated effect of chemical fertilization may be due to the role of chemical on supplying the plants with their required nutrients for more carbohydrates and proteins production which are necessary for vegetative, flowering, bulbs growth and chemical composition of *Hippeastrum vittatum* plants **(Marschner, 1995).**

The aforementioned results of chemical composition measurements concerning chemical fertilizer are coincided with those obtained by **Shahin (1998)** on *Hemerocallis aurantiaca*, demonstrated that spraying the plants with greenzit (foliar fertilizer containing macro and micro elements) at the rates of 1, 3 or 5cm^3 per liter increased leaf N, P, K and total carbohydrates content, **Naglaa and Kandeel (2001)**, **Ataa-Alla and Zaghloul (2002)** on *Iris tingitana*, **Youssef (2004)** on *Strelitzia reginae*, **El-Sayed (2004)** on *Iris tingitana*, **Abou-El-Ella (2007)** on *Acanthus mollis* and **Youssef and Goma (2007)** showed that spraying *Iris tingitana* plants with stimufol fertilizer at 4 or 6 g/L significantly increased leaf N, P, K and total carbohydrates content, **Taha (2012)** fertilizing iris plant with commercial foliar fertilizers (namely Singral, Allgrow and Manfret "B", each at 0.05, 0.1 and 0.2 %) increased leaf nitrogen, phosphorus, potassium, and total carbohydrates contents, especially the high level (0.2%), **Seyedeh *et al.* (2015)** fertilizing narcissus (*Narcissus tazetta*) plant with potassium nitrate (KNO_3) at 2 or 4g/plant increased leaf nitrogen, phosphorus, potassium, and total carbohydrates contents, especially the high level (0.2%), **Youssef and Abd El-Aal (2014)** revealed that fertilizing *Hippeastrum vittatum* plants with chemical fertilizer (NPK) at 6 g/plant improved the tested chemical constituents parameters i.e., leaf nitrogen, phosphorus, potassium, and total carbohydrates contents and **Ghatas (2015)** revealed that fertilizing *Hemerocallis aurantiaca* plants with NPK chemical fertilizer at 3 and 6 g/plant increased leaf nitrogen, phosphorus, potassium, and total carbohydrates contents.

Table 7. Effect of bulb size and chemical fertilization on leaf N and P (%) of *Hippeastrum vittatum* plant during 2019 and 2020 seasons

Bulb size(a) / Fertiliz. (b)	Leaf N (%)				Leaf P (%)			
	Small	Medium	Large	Mean	Small	Medium	Large	Mean
1st season								
0	1.36	1.41	1.56	1.44	0.202	0.212	0.218	0.211
2g/plant	1.39	1.43	1.61	1.48	0.214	0.219	0.226	0.22
4g/plant	1.48	1.46	1.68	1.54	0.212	0.232	0.241	0.228
6g/plant	1.46	1.52	1.73	1.57	0.216	0.231	0.249	0.232
Mean	1.42	1.46	1.51		0.211	0.224	0.234	
L.S.D at 0.05	a=0.06	b =0.07	a*b= 0.12		a=0.01	b =0.01	a*b= 0.02	
2nd season								
0	1.42	1.58	1.64	1.55	0.211	0.236	0.239	0.229
2g/plant	1.52	1.61	1.73	1.62	0.216	0.242	0.246	0.235
4g/plant	1.49	1.69	1.82	1.67	0.224	0.241	0.251	0.239
6g/plant	1.57	1.67	1.89	1.71	0.222	0.248	0.258	0.243
Mean	1.5	1.64	1.77		0.218	0.242	0.249	
L.S.D at 0.05	a=0.08	b =0.09	a*b=0.16		a=0.01	b =0.01	a*b= 0.02	

Table 8. Effect of bulb size and chemical fertilization on leaf K (%), leaf total carbohydrates (%) and leaf total chlorophylls (mg/100g fw) of *Hippeastrum vittatum* plant during 2019 and 2020 seasons

Bulb size(a) / Fertiliz. (b)	Leaf K (%)				Leaf total carbohydrate (%)				Leaf total chlorophylls (mg/100g fw)			
	Small	Medium	Large	Mean	Small	Medium	Large	Mean	Small	Medium	Large	Mean
1st season												
0	1.16	1.23	1.31	1.23	12.3	15.8	18.2	15.4	131.8	143.8	168.3	148
2g/plant	1.21	1.37	1.39	1.32	13.9	16.7	19.6	16.7	136.2	151.3	173.2	153.6
4g/plant	1.29	1.35	1.48	1.37	13.6	18.9	21.2	17.9	149.3	149.1	182.4	160.3
6g/plant	1.28	1.38	1.52	1.39	14.2	18.6	21.8	18.2	148.6	156.2	189	164.6
Mean	1.24	1.33	1.43		13.5	17.5	20.2		141.5	150.1	178.2	
L.S.D at 0.05	a=0.09	b =0.10	a*b=0.18		a=1.15	b =1.32	a*b=2.29		a=6.14	b =7.06	a*b=12.22	
2nd season												
0	1.19	1.28	1.38	1.28	13.4	16.2	19.3	16.3	146.2	156.5	173.8	158.8
2g/plant	1.28	1.34	1.42	1.35	14.2	17.3	20.6	17.4	151.3	161	182	164.8
4g/plant	1.26	1.46	1.53	1.42	15.1	17.1	21.8	18	149.2	169.2	194.3	170.9
6g/plant	1.31	1.45	1.58	1.45	15	18	22.4	18.5	158.2	169	196.4	174.5
Mean	1.26	1.38	1.48		14.4	17.2	20.9		151.2	163.9	186.6	
L.S.D at 0.05	a=0.08	b =0.09	a*b=0.16		a=1.34	b =1.54	a*b=2.67		a=5.34	b =6.14	a*b=10.62	

Conclusively, in order to produce good quality *Hippeastrum vittatum* plants, it is preferable to fertilize the large bulb size with chemical fertilization at 4 or 6g/plant. Additionally, fertilize the medium bulb size with chemical fertilization at 6g/plant could give the previously mentioned prospective traits.

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