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Effect of Growing Media and Mineral Fertilization on Growth, Flowering, Bulbs Productivity and Chemical Constituents of *Hippeastrum vittatum*, Herb.

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Abstract: The present study was designed to study the effect of different growing media (clay, composted leaves and sand + composted leaves (1: 1 v/v) and fertilizer rates of mineral NPK (19: 19: 19) at 0.0, 2.5, 5 g / plant and their combined effect on the vegetative growth, flowering qualities, bulbs production and chemical constituents of leaves of Amaryllis *(Hippeastrum vittatum*, Herb.) plants during 2006/07 and 2007/08 growing seasons at the nursery of Alexandria Univ., Egypt. The results indicated that using the different growing media had significant effect on the most of the most vegetative growth characteristics, flowering parameters, bulbs productivity and leaf chemical composition parameters (total chlorophylls content, N, P and K contents) in both seasons. The fertilization rates had significant effect on growth, flowering and bulbs production. On the other hand, the highest level of complete fertilizer (5 g / plant) was the best treatment for growth analysis, bulb fresh and dry weight and chemical constituents of leaves. Applying the complete fertilizer of N,P,and K (19: 19: 19) at 5 g / plant grown in composted leaves medium or its mixture with sand (1: 1 v/v) gave the maximum beneficial effect on the vegetative growth characteristics, flowering and bulbs and bulblets production. The highest significant increasing the total chlorophylls content, N, P and K contents in leaves and total carbohydrates content in bulbs were obtained by using the highest rate of complete fertilizer (5g) with the growing medium of sand + composted leaves (1: 1 v/v) in both seasons. It can be recommended that to produce high quality of *Hippeastrum vittatum*, plants for different decorative purposes in landscaping by cultivated them in the mixture of composted leaves medium or its mixture with sand (1: 1 v/v) and applying 5g/plant complete fertilizer NPK (19:19:19) monthly during the growing season.

Key words: Amaryllis plants · Mineral fertilization · Growing Medium · Flowering Bulbs

INTRODUCTION

Hippeastrum vittatum, Herb. belongs to the family Amaryllidaceae (Agavaceae). The most popular genus is *Hippeastrum*, usually called Amaryllis. They came originally from Peru and Chile and have been improved and varied by European growers, particularly the Dutch. *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 (2 -4 weeks).

It is known that potting media as well as nutritional requirements are the most important factors affecting flowering plants. However, no reports are available on description of bulb and flower production in Egypt, especially under Alexandria conditions, concerning growing media and fertilization. In this concern, Thabet *et al*. [1] mentioned that when onion bulbs were grown in media composed of a mixture of tafla:sandy soil (tafla = a soil conditioner containing 43% silt, 24% clay and 32% fine sand), the number of leaves, bulb FW, leaf and bulb DW were increased by increasing N - fertilization. At harvest, total yield, bulb FW and DW, water use efficiency and TSS increased with increasing

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N-fertilization. On Iris, Manoly [2] recorded that, sandy soil as a medium for growing plants was significantly capable for reducing number of days required for flowering stalk emergence and flower opening compared to clay soil. Stalk length, thickness and flower length, flower diameter, length and width and fresh and dry weights of flowers were significantly augmented by growing plants in clay soil in comparison with sandy one.

With respect to the effects of mineral fertilization on ornamental plants i.e., Afify [3] who reported that the fertilized gladiolus cultivars Peter Pears, Stardust and Daydream with higher rates of 20 N: 10 P: 15 K as a basal dressing produced the largest number of florets/spike, the longest spikes and flowering stems and the greatest fresh and dry corm weights. El-Khateeb *et al*.[4] mentioned that fertilizing *Freesia hybrida* cv. "Aurora" at 1 or 2 g/pot N combined with 2 g K/pot resulted in the greatest plant height and fresh and dry weights of leaves, while the greatest spike stem length was obtained with using 1 g N (ammonium nitrate) + 2 g K. Parthiban and Khader [5] revealed that application of 100 kg N + 75 kg P + 62.5 kg K/ha resulted in the highest number of spikes/plant, number of flowers/spike and the highest flower yield of tuberose cv. "Single". Clemens and Morton [6] investigated the optimum mineral nutrition for flower production in containerized Heliconia cv. "Golden Torch". The plants were grown in a greenhouse for 8 months under selected combinations of N, P and K. The maximum number of leaves was obtained at high N and P rates. Flower production was probably limited by declining solar radiation in autumn. The soil should be sandy with some organic matter [7]. Also, the long – season of Amaryllis required a good nutrient supply over a longer period for both vegetative and bulb growth [8].However, no reports are available on description of bulb and flower production under Egyptian condition.

So, the main objective of the present investigation were to evaluate the individual and combined effects of three selected growing media and three selected rates of mineral fertilization NPK applied throughout the growing season on growth, flowering and bulbs production as well as the chemical constitutes of leaves and bulbs produced.

MATERIALS AND METHODS

Pot experimental study was carried out at nursery of Alexandria Univ., Egypt throughout the two successive growing seasons of 2006/07 and 2007/08.

Plant Material: The Amaryllis bulbs (*Hippeastrum vittatum*, cv. Apple Blossom) with an average weight of 150 g and 6 cm in diameter were chosen for the present investigation. The bulbs were cultivated and planted in pots of 30 cm diameter (one bulbs / pot) packed with the three chosen growing media, mention later, in a full sunny place on 1st October, in both seasons (2006/07 and 2007/08).

Procedure and Lay-out of the Experiment: Two factors were involved in the present study, the first was potting media the second was mineral fertilization rate. The three different potting media chosen; clay,composted leaves and sand + composted leaves (1:1 v/v).The chemical analysis of the growing media used in the study are presented in the following Table 1.

The mineral fertilization doses of 0.0, 2.5 and 5 g (as, control. medium and high dose, respectively) were applied monthly as dressing application for six times throughout the growing season. The water soluble chemical fertilizer NPK (19:19:19) was used. The fertilization treatments started from 1st November in both seasons (2006/07 and 2007/08) until reaching the flowering stage [9].

The layout of the experiment was designed to provide a factorial experiment in randomized complete blocks. The study contained 9 treatments (3 potting media x 3 rates of mineral fertilization) with three replicates. Each experimental unit contained 5 plants. The study was terminated on 30th June during the two seasons.

Growth Parameters and Chemical Constituents: The following data were determined at the flowering time; number of leaves / plant at flowering time, leaf length and width (cm), total leaf fresh and dry weight / plant (g). While, the flowering data included; number of days from planting time to shown color of the first flower, number of

Table 1: The main chemical properties of the three chosen growing media

Growing media	EC mmohs/ cm	pH	Total P (ppm)	Total K (ppm)	Total N (ppm)	Fe (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)
Clay	3.40	7.40	10.25	794.02	239.45	7.69	5.49	20.42	7.18
composted leaves	2.92	7.78	26.00	634.00	325.84	7.96	3.02	8.02	1.54
Sand+composted leaves (1:1 v/v)	2.80	7.65	24.82	371.60	192.90	4.96	5.12	6.16	1.73

flowering stalk / plant, flower stalk length, flower stalk diameter, number of florets / flower stalk,. In addition, the recorded data of the bulbs and bulblets were; bulbs produced diameter at the end of the experiment, bulbs fresh and dry weight (g), number of new bulblets and their fresh and dry weight / plant. The data recorded for the chemical composition included; Leaf total chlorophyll content (mg/100g L.F.W.) was determined according to the method described by Moran and Porath [10]. The nitrogen and phosphorus content (mg/g L. D.W.) of the dried leaves were determined according to methods described by Chapman and Pratt [11] and Bringham [12].While the potassium content (mg/g L. D.W.) was determined according to the method described by Brown and Lilleland [13].

Statistical Analysis: The data on the growth characteristics were subjected to statistical analysis of variance and the means were compared using the "Least Significant Difference (L.S.D) " test at the 5% level, as described by Snedecor and Cochran [14].

RESULTS AND DISCUSSION

Vegetative Growth Characteristics

Number of Leaves / Plant: Data in Table 2 showed that there is no significant difference in the number of leaves / plant due to using the different growing media in plantation in both experimental trails. While, fertilizer treatments significantly increased number of leaves / plant; it increased with increasing fertilizer rate in the both season. The values reached to 7.65 and 7.82 leaves per plant as a result of receiving the plants 5g NPK fertilizer compared with the control (5.36 and 5.38 leaves) in both seasons, respectively. These results may be attributed to the influence of N at specific concentration on the growth of plant which led to new cells formation, consequently, increased number of leaves / plant [15]. Similar results were obtained by Amarjeet and Godara [16] who mentioned that, increasing rates of N, P and K increased number of leaves / plant of *Polianthes tuberosa*.

The interaction between growing media and fertilizer treatments showed the great influence of receiving the plants grown in composted leaves medium the highest rate of NPK treatment (5g). Such treatment increased number of leaves per plant to 8.25 and 8.50 leaves in both seasons, respectively.

Leaf Length and Width (cm): The obtained data in Table (2) showed the influence of either composted leaves medium or its mixture with sand on increasing in leaf length and width values in both seasons. The lowest value was obtained by using clay medium. These results are somewhat looks like that observed by Mohamed [17] on *Polianthes tuberosa*.

NPK fertilization revealed a significant increment in leaf length and width in the both seasons. The rate of 5 g fertilizer per plant gave the highest values of leaf length (40.36 and 40.35 cm) and width (2.83 and 2.87 cm) compared to the untreated plants in both seasons, respectively. These results are in agreement with those of Pal and Biswas [18] with *Polianthes tuberosa*.

Concerning the interaction, using composted leaves medium or its mixture with sand and applying the two NPK rates showed a favorable affect on leaf length and width in both plantations. The contrary action, was detected due to using clay medium with or without NPK fertilization

Total Leaf Fresh and Dry Weight / Plant (g): Obviously data in Table 3, indicate the superiority of using composted leaves medium in plantation in both experimental field. It considerably increment leaf fresh and dry weight / plant comparing with that recorded from the other growing media used in cultivation. Concerning the effect of NPK rates, it is obvious from the tabulated data the significant increasing in leaf fresh and dry weight / plant due to receiving the plants the high rate of NPK in both experimental trials. These results are in accordance with those obtained by Ali [19] on *Lawsonia inermis*. For the interaction, it could be concluded from the tabulated data, the great influence of receiving the plants grown in composted leaves the high rate of mineral fertilizer treatment. Such treatment increased leaf fresh weight to 119.96 and 123.72 g and increased leaf dry weight to 27.86 and29.24 g in the first and second seasons, respectively.

Flowering Characteristics

Number of Days to Flowering: Concerning the effect of different growing media and/or mineral fertilizers rates and their interactions on the flowering times recorded as a number of days from planting to shown color of the first flower. The data presented in Table 3, show that this trail was not significantly affected by using the different media and / or fertilizer levels in both seasons.

Number of Flowering Stalk /Plant: Evidently data in Table 4, revealed the increment on the number of flowering stalk/plant, due to using composted leaves or its mixture with sand in plantation in both experimental fields. Applying the high rates of NPK

Table 2: Means of number of leaves / plant, leaf length (cm) and leaf width (cm) of *Hippeastrum vittatum*, cv. Apple Blossom as affected by growing media, rate of mineral fertilizer and their interaction during 2006/07and 2007/08 seasons

Number of leaves /plant

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	5.35	5.42	5.36	5.38	Control	5.38	5.40	5.35	5.38
Medium NPK	6.76	7.92	7.35	7.33	Medium NPK	6.79	7.96	7.37	7.37
High NPK	7.22	8.25	7.48	7.65	High NPK	7.35	8.50	7.61	7.82
Mean	6.44	7.20	6.71		Mean	6.51	7.27	6.78	
L.S.D. $_{(0.05)}$	For growing media = NS				L.S.D. $_{(0.05)}$	For growing media = NS			
	For rate of fertilization = 0.43					For rate of fertilization = 0.50			
	For the interaction = 0.69					For the interaction = 0.79			

Leaf length (cm)

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	33.65	35.23	36.29	35.06	Control	31.95	35.26	35.75	34.32
Medium NPK	36.02	41.17	39.11	39.77	Medium NPK	35.89	42.12	39.55	39.19
High NPK	36.92	43.91	40.25	40.36	High NPK	36.18	42.00	42.86	40.35
Mean	35.53	40.10	38.55		Mean	34.67	39.79	39.38	
L.S.D. $_{(0.05)}$	For growing media = 2.15				L.S.D. $_{(0.05)}$	For growing media = 2.22			
	For rate of fertilization = 2.15					For rate of fertilization = 2.22			
	For the interaction = 4.30					For the interaction = 4.53			

Leaf width (cm)

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	1.76	1.98	2..05	1.93	Control	1.74	1.85	2.10	1.90
Medium NPK	2.19	3.11	3.12	2.81	Medium NPK	2.22	3.16	3.13	2.84
High NPK	2.54	3..09	2.89	2.84	High NPK	2.59	3.11	2.92	2.87
Mean	2.16	2.73	2.69		Mean	2.18	2.71	2.72	
L.S.D. $_{(0.05)}$	For growing media = 0.39				L.S.D. $_{(0.05)}$	For growing media = 0.42			
	For rate of fertilization = 0.39				For rate of fertilization =.042				
	For the interaction = 0.52					For the interaction = 0.57			

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 level of probability.

Table 3: Means of total leaf fresh and dry weight / plant (g) and number of day to flowering (day) of *Hippeastrum vittatum*, cv. Apple Blossom as affected by growing media, rate of mineral fertilizer and their interaction during 2006/07and 2007/08 seasons

Total leaf fresh weight / plant (g)

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	82.19	87.47	87.58	85.77	Control	82.23	88.00	87.46	85.90
Medium NPK	106.26	114.53	110.49	110.43	Medium NPK	105.98	116.36	110.79	111.04
High NPK	110.58	119.96	115.27	115.27	High NPK	111.09	123.72	114.36	116.39
Mean	99.68	107.32	104.47		Mean	99.77	109.36	104.20	
L.S.D. $_{(0.05)}$	For growing media = 3.22				L.S.D. $_{(0.05)}$	For growing media = 4.10			
	For rate of fertilization = 3.22					For rate of fertilization = 4.10			
	For the interaction = 5.94					For the interaction = 6.13			

Table 3: Continued

Total leaf fresh weight / plant (g)

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	18.49	18.95	18.79	18.74	Control	18.43	19.14	18.67	18.75
Medium NPK	20.79	23.57	21.47	21.94	Medium NPK	20.74	23.86	23.94	22.85
High NPK	24.12	27.86	23.54	25.17	High NPK	23.97	29.24	23.22	25.48
Mean	21.13	23.46	23.46		Mean	21.05	24.08	21.94	
L.S.D. $_{(0.05)}$	For growing media = 1.12				L.S.D. $_{(0.05)}$	For growing media = 1.32			
	For rate of fertilization = 1.12					For rate of fertilization = 1.32			
	For the interaction = 2.09					For the interaction = 2.19			

Number of days from planting to flowering (day)

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	202.79	201.68	197.54	200.67	Control	204.25	201.33	198.45	201.34
Medium NPK	200.24	195.42	193.39	196.35	Medium NPK	201.36	196.72	193.56	197.21
High NPK	201.53	197.76	195.45	198.25	High NPK	203.41	199.58	195.50	199.50
Mean	201.52	198.29	195.46		Mean	203.01	199.21	195.84	
L.S.D. $_{(0.05)}$	For growing media = NS				L.S.D. $_{(0.05)}$	For growing media = NS			
	For rate of fertilization = NS					For rate of fertilization = NS			
	For the interaction = NS					For the interaction = NS			

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 level of probability

Table 4: Means of number of flowering stalk / plant and flower stalk length (cm) and Stalk diameter (cm) of *Hippeastrum vittatum*, cv. Apple Blossom as affected by growing media, rate of mineral fertilizer and their interaction during 2005/06 and 2006/07 seasons

Number of flowering stalk / plant

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	1.17	1.26	1.30	1.24	Control	1.21	1.30	1.36	1.29
Medium NPK	1.37	1.65	1.89	1.64	Medium NPK	1.37	1.69	1.92	1.96
High NPK	2.07	2.24	2.50	2.27	High NPK	2.09	2.40	2.55	2.35
Mean	1.54	1.72	1.90		Mean	1.56	1.80	1.94	
L.S.D. $_{(0.05)}$	For growing media = 0.19				L.S.D. $_{(0.05)}$	For growing media = 0.22			
	For rate of fertilization = 0.21				For rate of fertilization = 0.25				
	For the interaction = 0.40					For the interaction = 0.51			

Flower stalk length (cm)

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	43.82	46.76	46.59	45.72	Control	44.36	46.79	47.06	46.07
Medium NPK	47.21	59.19	56.29	54.23	Medium NPK	49.24	61.98	56.85	56.02
High NPK	49.60	63.13	60.54	57.77	High NPK	50.46	62.25	60.77	57.83
Mean	46.88	56.36	54.47		Mean	48.02	57.01	54.89	
L.S.D. $_{(0.05)}$	For growing media = 3.46				L.S.D. $_{(0.05)}$	For growing media = 4.40			
	For rate of fertilization = 3.46					For rate of fertilization = 4.40			
	For the interaction = 5.96					For the interaction = 7.52			

Table 4: Continued

Stalk diameter (cm)									
First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	1.69	1.83	1.76	1.76	Control	1.65	1.87	1.81	1.78
Medium NPK	2.21	3.72	3.46	3.13	Medium NPK	2.26	3.75	3.49	3.17
High NPK	2.38	3.51	3.39	3.09	High NPK	2.33	3.49	3.40	3.07
Mean	2.09	3.02	2.87		Mean	2.08	3.04	2.90	
L.S.D. (0.05)	For growing media = 0.78				L.S.D. (0.05)	For growing media = 0.82			
	For rate of fertilization =.078					For rate of fertilization = 0.82			
	For the interaction = 1.32					For the interaction = 1.49			

L.S.D (0.05) = Least significant differences at 0.05 level of probability

fertilizer significantly increased the number of flowering stalk /plant, in both seasons compared with the other treatments. However, the high NPK rate increased the total values to 2.27 and 2.35 in the first and second seasons respectively. As for the control, it gave total values of 1.24 and 1.29 for both seasons, respectively. This result agrees with that obtained by El-Fawakhry *et al.* [20]. The interaction between the growing media and different fertilizers rates revealed the superiority of growing the plants in different media and receiving the high rate of fertilizer treatment (5g) for increasing number flowering stalk /plant in both experimental fields (2.50 and 2.55, respectively) as comparing with other interaction treatments. It was observed that the lowest values was obtained from the plants grown in clay medium without NPK fertilization, as the values were decreased to only 1.17 and 1.21 in the first and second seasons, respectively.

Flower Stalks Length and Diameter (cm): Growing the plants in composted leaves or their mixture with sand medium significantly increased the stalk length and diameter than that obtained from the other growing media used (clay) in cultivation in both seasons, as can be seen in Table 4. Receiving the plants the highest rate of NPK treatment significantly increased the stalk length and diameter as compared with control treatment.For the interaction, it could be mentioned that plants grown in either composted leaves media or its mixture with sand and received the two rates of NPK gave considerably more stalk length and diameter compared with the recorded from plants grown in clay medium and untreated with NPK fertilization.

Number of Florets/ Flower Stalk: Data in Table 5 show the increment on number of florets/ flower stalk due to using composted leaves medium in cultivation as the values reached to 3.52 and 3.62 in the first and second seasons, respectively. Whereas, planting in the clay media gave significantly decreased in florets number as compared with other media. However, growing the plants in clay medium produced the lowest number of florets/ flower stalk in this concern (1.96 and 1.99) in both seasons. Using the highest rate of NPK treatment (5g) significantly increased number of florets/ flower stalk compared with that obtained from the control treatments in both experimental trials. Concerning the interaction, it could be concluded that receiving the plants the high or medium NPK rate with plants grown in compost medium or mixed with sand were the best treatments for increasing number of florets/ flower stalk in both seasons.

Flower Diameter (cm) and Fresh Weight of Flower Stalk (g): The data presented in Table 5 indicated that, the parameters of first flower diameter and Fresh weight of flower stalk were increased by composted leaves medium and its mixture with sand compared to clay medium. Also, NPK fertilization at both rates (2.5 and/or5g) increased these parameters. Moreover, the combined effects between the composted leaves medium and its mixture with sand and the two rates of NPK fertilizer in both seasons increased the flower diameter and fresh weight of flower stalk in both experimental trials.

Bulbs and Bulblets Characteristics: Obviously data in Table 6 and 7 indicated that the superiority of using sand + composted leaves (1:1 v/v) medium in plantation in both experimental field. It considerably increment bulbs and bulblets productivity in both seasons, such as bulbs diameter, bulbs fresh and dry weight, number of bulblets/ plant, fresh and dry weight of bulblets plant (giving values of 7.58 cm, 172.48g, 38.31 g, 2.99, 68.98 g and 12.76 g, respectively in the first season and 7.56 cm, 172.84g, 38.83g, 3.05, 68.72 g and 12.76 g, respectively,

Table 5: Means of number of florets / flower stalk, flower diameter (cm) and fresh weight of flower stalk (g) of *Hippeastrum vittatum*, cv. Apple Blossom as affected by growing media, rate of mineral fertilizer and their interaction during 2006/07and 2007/08 seasons

Number of florets / flower stalk

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	1.77	2.84	2.65	2.42	Control	1.80	2.97	2.70	2.49
Medium NPK	1.98	3.97	3.58	3.18	Medium NPK	1.98	4.00	3.61	3.20
High NPK	2.13	3.75	3.69	3.19	High NPK	2.19	3.88	3.68	3.25
Mean	1.96	3.52	3.31		Mean	1.99	3.62	3.33	
L.S.D. $_{(0.05)}$	For growing media =0.19				L.S.D. $_{(0.05)}$	For growing media = 0.19			
	For rate of fertilization = 0.19					For rate of fertilization = 0.19			
	For the interaction = 0.22					For the interaction = 0.22			

Flower diameter (cm)

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	5.65	5.80	5.93	5.79	Control	5.78	5.88	5.93	5.86
Medium NPK	5.97	6.35	6.27	6.19	Medium NPK	5.96	6.33	6.25	6.18
High NPK	5.99	6.54	6.50	6.34	High NPK	6.02	6.56	6.54	6.37
Mean	5.87	6.17	6.23		Mean	5.92	6.26	6.24	
L.S.D. $_{(0.05)}$	For growing media = 0.16				L.S.D. $_{(0.05)}$	For growing media = 0.16			
	For rate of fertilization = 0.16					For rate of fertilization = 0.16			
	For the interaction = 0.30					For the interaction = 0.30			

Fresh weight of flower stalk (g)

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	142.67	152.09	150.54	148.43	Control	140.98	153.78	151.21	148.66
Medium NPK	147.13	159.64	158.12	154.96	Medium NPK	147.20	162.49	160.93	156.87
High NPK	149.42	157.83	156.32	154.52	High NPK	149.59	158.77	157.67	15534
Mean	146.41	156.52	154.99		Mean	145.92	158.35	156.60	
L.S.D. $_{(0.05)}$	For growing media = 1.91				L.S.D. $_{(0.05)}$	For growing media = 1.79			
	For rate of fertilization = 1.91					For rate of fertilization = 1.79			
	For the interaction = 3.40					For the interaction = 2.95			

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 level of probability

Table 6: Means of bulb diameter (cm), bulb fresh and dry weight (g), of *Hippeastrum vittatum*, cv. Apple Blossom as affected by growing media, rate of mineral fertilizer and their interaction during 2006/07and 2007/08 seasons

Bulb diameter (cm)

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	6.13	7.11	6.99	6.74	Control	6.21	7.10	7.00	6.77
Medium NPK	6.57	7.63	7.76	7.32	Medium NPK	6.45	7.70	7.73	7.29
High NPK	7.03	7.81	7.99	7.61	High NPK	6.97	7.83	7.95	7.58
Mean	6.57	7.51	7.58		Mean	6.54	7.54	7.56	
L.S.D. $_{(0.05)}$	For growing media = 0.48				L.S.D. $_{(0.05)}$	For growing media = 0.43			
	For rate of fertilization = 0.48					For rate of fertilization = 0.43			
	For the interaction = 0.95					For the interaction = 0.92			

Table 6: Continued

Bulb fresh weight (g)

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	159.30	163.74	168.83	163.99	Control	159.69	163.77	169.00	164.15
Medium NPK	161.46	168.49	172.45	167.47	Medium NPK	160.87	169.97	172.28	167.71
High NPK	162.38	173.97	176.15	170.84	High NPK	162.97	175.56	177.23	171.92
Mean	161.05	168.73	172.48		Mean	161.18	169.77	172.84	
L.S.D. $_{(0.05)}$	For growing media = 1.57				L.S.D. $_{(0.05)}$	For growing media = 1.35			
	For rate of fertilization = 1.57					For rate of fertilization = 1.35			
	For the interaction = 2.49					For the interaction = 2.27			

Bulb dry weight (g)

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	33.15	35.74	37.14	35.34	Control	33.21	35.75	37.25	35.40
Medium NPK	34.37	37.48	39.02	36.96	Medium NPK	34.36	37.45	38.97	36.93
High NPK	34.96	39.72	40.28	38.23	High NPK	34.97	39.18	40.26	38.14
Mean	34.16	37.65	38.31		Mean	34.18	37.46	38.83	
L.S.D. $_{(0.05)}$	For growing media = 0.68				L.S.D. $_{(0.05)}$	For growing media = 0.97			
	For rate of fertilization = 0.68					For rate of fertilization = 0.97			
	For the interaction = 1.17					For the interaction = 1.69			

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 level of probability

Table 7: Means of number of bulblets/ plant, fresh and dry weight of bulblets / plant of *Hippeastrum vittatum*, cv. Apple Blossom as affected by growing media, rate of mineral fertilizer and their interaction during 2006/07and 2007/08 seasons

Number of bulblets/ plant

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	1.37	1.58	2.19	1.71	Control	1.35	1.55	2.29	1.73
Medium NPK	1.49	2.85	3.10	2.48	Medium NPK	1.45	2.90	3.16	2.50
High NPK	1.72	3.39	3.68	2.93	High NPK	1.77	3.46	3.71	2.98
Mean	1.53	2.61	2.99		Mean	1.52	2.64	3.05	
L.S.D. $_{(0.05)}$	For growing media = 0.39				L.S.D. $_{(0.05)}$	For growing media = 0.31			
	For rate of fertilization = 0.39					For rate of fertilization = 0.31			
	For the interaction = 0.76					For the interaction = 0.60			

Bulblets fresh weight (g)

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	58.20	63.86	65.93	62.66	Control	55.98	63.42	64.62	61.34
Medium NPK	60.15	67.84	67.82	65.27	Medium NPK	60.11	67.88	67.90	65.30
High NPK	61.75	70.64	73.20	68.53	High NPK	62.86	70.70	73.65	69.07
Mean	60.03	67.44	68.98		Mean	59.65	67.33	68.72	
L.S.D. $_{(0.05)}$	For growing media = 0.91				L.S.D. $_{(0.05)}$	For growing media = 0.97			
	For rate of fertilization = 0.91					For rate of fertilization = 0.97			
	For the interaction = 1.62					For the interaction = 1.65			

Table 7: Continued

Bulblets dry weight (g)									
First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	9.43	11.19	12.27	10.96	Control	9.22	11.14	12.25	10.87
Medium NPK	9.71	12.39	12.86	11.65	Medium NPK	9.73	12.36	12.88	11.66
High NPK	10.29	12.85	13.15	12.10	High NPK	10.37	12.85	13.15	12.12
Mean	9.81	12.14	12.76		Mean	9.77	12.12	12.76	
L.S.D. $_{(0.05)}$	For growing media = 0.21				L.S.D. $_{(0.05)}$	For growing media = 0.17			
	For rate of fertilization = 0.21					For rate of fertilization = 0.17			
	For the interaction = 0.36					For the interaction = 0.28			

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 level of probability

in the second season for the above mentioned parameters) comparing with that recorded from the other growing media used in cultivation. These results are in agreement with those obtained by Khalafalla *et al*. [21] on *Ornithogalum thyrosoides* reported that composted leaves with sand caused an increase in fresh and dry weight and circumference of bulbs /plant.

Concerning the effect of mineral fertilization rates, it is obvious from the tabulated data the significant increment on Bulbs and bulblets characteristics due to receiving the plants the high rates of NPK fertilizer (5g) compared with the control in both experimental trials. High level of NPK fertilization has been found to increase the vegetative growth and enhanced the growth of bulbs and bulblets.In this connection, EL-Naggar [22] on *Gladiolus hybrida* and EL-Bably [23] on *Polianthes tuberosa*, reported the beneficial effects of NPK on bulbs and bulblets productivity.In this consideration, Marschner [24] reported that application of NPK accelerated growth of plant by increasing the synthesis of protein and protoplasm. From the interaction, it could be concluded from the tabulated data, the great influence was obtained by the plants grown in sand + composted leaves (1:1 v/v) media with the high rates of NPK (5g) fertilizer. The contrary action was detected as a result of growing the plants in clay medium without NPK fertilization in both seasons as seen in Table 6 and 7. Similar results were obtained by Nabih [25] on *Freesia refracta*.

Chemical Constituents

Leaf Total Chlorophylls Content (mg/100 g F.W.): The results presented in Table 8 revealed that the highest values of total chlorophylls content of leaves, resulting from growing the plants in composted leaves in the first season and sand + composted leaves (1:1 v/v) in the second season. Such treatment increased the values to 190.52 and 195.88 mg/100 g F.W. in the first and second seasons, respectively.

Using the high rate of fertilizer treatments, gave a great increase was observed in total chlorophylls content with increasing fertilizer rates compared to the control. The values reached to 197.69 and 198.62 mg/100 g F.W. against to 177.74 and 178.30 mg/100 g F.W. resulted from using t he control treatment in the first and second seasons, respectively. High fertilizer rates may increase the availability of nitrogen and this consequently increases its absorption by the plant. It is well known that nitrogen is presented in chlorophyll molecule. This result agrees with those obtained by Jie *et al*. [26] on Heliconia.

In general, the interaction between growing media and fertilizer treatments showed the great influence of the plants grown in sand + composted leaves (1:1 v/v/v) medium with the highest rate of fertilizer treatment (5g). The contrary action was a result of using the plants grown in clay medium the without NPK treatment. It decreased the values to only 172.45 and 174.25 mg/100g F.W. in the first and second seasons, respectively.

Leaf Nitrogen and Phosphorus Contents (mg/g L.D.W.): N and P contents in leaves, as shown in Table 8, were significantly increased as a result of using composted leaves as compared with other media. Whereas, the lowest values were obtained resulting from using clay in cultivation. The obtained data reveal that the fertilizer rates significantly affected N and P contents in the leaves. A gradual increase of N and P contents was recorded with increasing the rate of fertilizer. These results are in accordance with those obtained by Koriesh *et al*. [27] on rose cv. "Baccara". They found an increase in N and P percentages in the leaves by using different NPK fertilizer levels.

Table 8: Means of Total chlorophylls content (mg/100 g leaf fresh weight) of *Hippeastrum vittatum*, cv. Apple Blossom as affected by growing media, rate of mineral fertilizer and their interaction during 2006/07and 2007/08 seasons.

Total chlorophylls content (mg/100 g leaf fresh weight)

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	172.45	179.74	181.02	177.74	Control	174.25	177.51	183.14	178.30
Medium NPK	183.14	187.97	185.00	185.37	Medium NPK	186.70	190.20	197.63	191.51
High NPK	188.54	203.85	200.67	197.69	High NPK	189.63	199.38	206.86	198.62
Mean	181.38	190.52	188.90		Mean	183.53	189.03	195.88	
L.S.D. $_{(0.05)}$	For growing media = 1.51				L.S.D. $_{(0.05)}$	For growing media = 1.47			
	For rate of fertilization = 1.51					For rate of fertilization = 1.47			
	For the interaction = 3.70					For the interaction = 3.62			

Leaf nitrogen content (mg/g D.W.)

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	1.760	1.814	1.839	1.804	Control	1.782	1.809	1.842	1.811
Medium NPK	2.120	2.395	2.420	3.117	Medium NPK	2.113	2.390	2.425	2.309
High NPK	3.517	3.784	3.797	3.699	High NPK	3.520	3.781	3.801	3.701
Mean	2.466	2.664	2.685		Mean	2.472	2.660	2.689	
L.S.D. $_{(0.05)}$	For growing media = 0.089				L.S.D. $_{(0.05)}$	For growing media = 0.033			
	For rate of fertilization = 0.132					For rate of fertilization = 0.052			
	For the interaction = 0.181					For the interaction = 0.079			

Leaf phosphorus content (mg/g D.W.)

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	0.137	0.142	0.152	0.144	Control	0.139	0.142	0.150	0.144
Medium NPK	0.205	0.239	0.315	0.253	Medium NPK	0.209	0.237	0.310	0.252
High NPK	0.283	0.329	0.360	0.324	High NPK	0.291	0.331	0.361	0.328
Mean	0.208	0.237	0.276		Mean	0.213	0.237	0.274	
L.S.D. $_{(0.05)}$	For growing media = 0.007				L.S.D. $_{(0.05)}$	For growing media = 0.004			
	For rate of fertilization = 0.005					For rate of fertilization = 0.003			
	For the interaction = 0.039					For the interaction = 0.025			

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 level of probability

Table 9: Means of bulb fresh and dry weight (g), bulb diameter (cm) of *Hippeastrum vittatum*, cv. Apple Blossom as affected by growing medium, rate of mineral fertilizer and their interaction during 2006/07and 2007/08 seasons

Leaf potassium content (mg/g D.W.)

First season (2006/07)					Second season (2007/08)				
Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean	Mineral fertilizer Rates	Clay	Composted leaves	Sand+Compost	Mean
Control	1.339	1.628	1.699	1.555	Control	1.410	1.630	1.705	1.582
Medium NPK	1.748	1.974	2.00	1.907	Medium NPK	1.750	1.871	1.997	1.873
High NPK	1.920	2.058	2.119	2.032	High NPK	1.917	2.082	2.115	2.038
Mean	1.669	1.887	1.939		Mean	1.692	1.861	1.939	
L.S.D. $_{(0.05)}$	For growing media = 0.073				L.S.D. $_{(0.05)}$	For growing media = 0.069			
	For rate of fertilization = 0.057					For rate of fertilization = 0.051			
	For the interaction = 0.097					For the interaction = 0.102			

L.S.D $_{(0.05)}$ = Least significant differences at 0.05 level of probability

Concerning the interaction between growing medium and fertilizer rates, the obtained results indicated that, application of the highest fertilizer rate (5 g) to plants growing in composted leaves medium and its mixture with sand resulted in the highest N and P contents in the leaves.

Leaf Potassium Content (mg/g L.D.W.): Data presented in Table 9 revealed that a significant differences in leaf potassium content due to the different growing medium. Highest K content values were obtained with plants grown in sand + composted leaves (1:1 v/v) medium, while clay medium resulted in a significant reduction in the K values. The results indicated that the fertilizer rates significantly affected potassium content in the leaves. Whereas, the highest K value was recorded with using 5 g fertilizer followed by 2.5 g fertilizer, compared to the control. This result agrees with that obtained by Singh *et al.* [28] on *Gladiolus grandiflorus*.

Concerning the interaction, the highest K content in the leaves was observed with plants grown in sand + composted leaves (1:1 v/v) medium and receiving 5 g fertilizer, while it decreased to the least value with plants grown in clay medium under without receiving any fertilizer.

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