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# Response of *Hemerocallis aurantiaca* Plants to Kinetin and Chemical Fertilization Treatments

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**ABSTRACT**

Two field trials were carried out to study the effect of 16 treatments represented the combination between four concentrations of kinetin (0.0, 25, 50 and 75 ppm.) and four levels of mineral fertilization (0.0, 2, 4 and 6 g/plant) on the growth, flowering, and chemical composition of *Hemerocallus aurantiaca* plant. Results showed that the three concentrations of kinetin increased vegetative growth parameters i.e., number of leaves/plant, fresh and dry weights of leaves/plant and number of offshoots/clumb for the flowering growth parameters i.e., number of days required from planting to start flowering, number of flower, flower stalk length, diameter, fresh and dry weights of flower stalk, duration of flower on plant and flower vase life positively were affected, as the same as chemical composition parameters i.e., leaf total carbohydrates , N, P and K contents with superior to the medium and high rates. Also, all levels of NPK fertilizer significantly improved all the abovementioned parameters, especially using the medium and high levels. Additionally, most of the combinations between kinetin concentrations and levels of NPK fertilizer improved all the studied parameters, particularly using the combinations between kinetin at 50 or75 ppm and NPK fertilizer at 4 or 6 g/L in both seasons. Conclusively, from the aforementioned results, it could be recommend that : to obtain the best vegetative and flowering characteristics with high quality of *Hemerocallis aurantiaca*; the plants should be sprayed with the treatment of kinetin at 75 ppm and combined with NPK at 6 g/plant that is being accompanied with vigorous vegetative and flowering growth and good quality as well.

***Key words:*** *Hemerocallis aurantiaca*, vegetative growth, flowering, chemical constituents, kinetin and fertilization.

## 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. *Hemerocallis aurantiaca*, Baker ( hemero, a day; kallos, beauty; in reference to the flowers being fresh only for only day or so) belongs closely to Fam. Asphodlaceae not to Fam. Liliaceae, is a very short rhizome with numerous more or less tuberous and fleshy roots, native to Japan and commonly known as golden summer daylily or orange daylily. It is well known for its hardiness and showy blooms produced during spring and summer (Oganezova, 1990).

Hemerocallis is an indispensable choice for woodland and landscape gardens, when grown in the background or herbaceous borders, in front of a shrubbery or along the sides of ponds or streams, a highly delightful effect is produced. Daylily is also used as a cut flower. (Bose and Yadav, 1989). Ornamental bulbs are greatly influenced by different growth regulators among which kinins group. Kinetin is recognized by its ability to induce cell division in certain plant tissues (Cheema and Sharma, 1982) it can also overcome the apical dominance of many plants and stimulate the lateral buds to develop into an entire new plant. Kinetin can delay senescence and cause transport of many solutes from older parts of the leaves or even from older leaves into the treated zone (Salisbury and Ross, 1974). In this respect, Youssef and Ismaeil (2009) indicated that 200 ppm kinetin-sprayed plants improved all studied vegetative and flowering growth traits of *Clivia miniata* plants. Additionally, Youssef and Mady (2013) cleared that spraying *Aspidistra elatior* plants with benzyladenine at 75ppm improved all tested vegetative and chemical constituents of this plants. Furthermore, Youssef and Abd El-Aal (2014) indicated that 60 ppm kinetin-sprayed plants improved most of the studied vegetative and flowering growth traits of *Hippeastrum vittatum* plants.

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, El-Nagar and El-Nasharty (2009)

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revealed that fertilized *Hippeastrum vittatum* with mineral fertilization at 5g/plant gave the maximum beneficial effect on the vegetative growth characteristics, flowering , bulb and bulblets production. Also, Youssef and Abd El-Aal (2014) revealed that fertilizing *Hippeastrum vittatum* plants with chemical fertilizer (NPK) at 6 g/plant improved the tested vegetative and flowering growth parameters. Therefore, this study was carried out to investigate the effect of kinetin and mineral fertilization (NPK) on growth, flowering, and chemical composition of *Hemerocallis aurantiaca* plant.

## Materials and Methods

This investigation was carried out in the open field at the Floriculture Nursery of the Horticulture Department, Faculty of Agriculture at Moshtohor, Benha University, during 2012/2013 and 2013/2014 seasons to study the effect of kinetin treatments (0, 25, 50 and 75 ppm) and some chemical fertilization treatments (0, 2, 4 and 6 g/plant) in combining treatments to lump their benefits in producing high quality flowers of *Hemerocallis aurantiaca* plants.

*Plant material:*

Divisions of *Hemerocallis aurantiaca*, Baker clumps "local variety" at the weight of 80-85 g were obtained freshly from floriculture Nursery of the Horticulture Department, Faculty of Agriculture at Moshtohor, Benha University.

*Planting procedure:*

Divisions of hemerocallis clumps were planted in clay loam soil on mid October in beds 1x1m2 as every bed containing 4 divisions planted at 50x50 cm in between in both seasons. "(the analyses of the used soil are presented in Tables (a,b)".

**Table (a):** Mechanical analysis of the experimental soil.

| Parameters | Unit | Seasons | |
|---|---|---|---|
| | | 2012/2013 | 2013/2014 |
| Coarse sand | % | 5.26 | 4.99 |
| Fine sand | % | 16.18 | 15.84 |
| Silt | % | 25.39 | 26.67 |
| Clay | % | 53.17 | 52.50 |
| Textural class | ------ | Clay loam | Clay loam |

**Table (b):** Chemical analysis of the experimental soil.

| Parameters | Unit | Seasons | |
|---|---|---|---|
| | | 2012/2013 | 2013/2014 |
| $CaCo_3$ | % | 1.16 | 1.21 |
| Organic matter | % | 1.39 | 1.74 |
| Available nitrogen | % | 0.79 | 0.86 |
| Available phosphorus | % | 0.38 | 0.41 |
| Available potassium | % | 0.76 | 0.81 |
| E.C | ds/m | 1.31 | 1.39 |
| pH | ---------- | 7.64 | 7.58 |

*Fertilization treatments:*

*Hemerocallis aurantiaca* plants 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 2:1:2 (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 six times at monthly intervals, starting at mid February in the two seasons.

*Kinetin treatments:*

*Hemerocallis aurantiaca* plants were subjected to foliar spray with kinetin at the rates of 0, 25, 50 and 75 ppm four times, each at one month interval, the first one was after four months from planting time in both seasons. A surfactant (Tween 20) at a concentration of 0.01% was added to all sprayed solutions including the control.

*Experiment layout:*

The design of this experiment was factorial experiments in a complete randomized block design with 16 treatments represented the combinations between kinetin at the rates of 0, 25, 50 and 75 ppm and chemical fertilization at the rates of 0, 2, 4 and 6 g/ plants (4 chemical fertilization levels x 4 kinetin concentrations) replicated three times (each replicate consisted of five beds, with four bulbs/bed). Common agricultural practices (irrigation, manual weed control,… etc.) were carried out when needed.

*Recorded data:*

1- Vegetative growth parameters:

Number of leaves/clump, number of offshoots/clump and fresh and dry weights of leaves.

2-Flowering growth parameters:

Flowering start (days), number of flowers/clump, length and diameter of flower stalk, fresh and dry weights of flower (g), duration of flower on plant (days) and flower vase life (days).

3- Chemical composition determinations:

Total nitrogen percentage was determined in the dried leaves by using modified micro-kjeldahl method as described by Pregl (1945).

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

-Potassium content was determined by flame photometer according to Brown and Lilleland (1946).

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

All samples for chemical analyses were taken at the flowering start.

*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

### 1-Vegetative growth parameters:

*b- Leaves and offshoots number/ plant:*

Data in Table (1) declared that all studied kinetin and NPK individual treatments as well as their interactions increased the number of leaves/plant in both seasons. In this respect , the increment of leaves number were in parallel to applied concentration of kinetin and fertilization levels, so the highest concentration of kinetin or the highest level of fertilization significantly scored the greatest number of leaves / plant when compared with control in both seasons. However, the highest number of leaves/plant (26.9 and 22.9) and offshoots (4.72 and 4.18) were recorded by 75 ppm kinetin-sprayed plants combined with NPK fertilization at 6 g/ plant in the first and second seasons, respectively.

**Table 1:** Effect of kinetin and fertilization treatments on number of leaves and offshoots/ clump of *Hemerocallis aurantiaca* plants during 2012/2013 and 2013/2014 seasons.

| Parameters / Treatments | | Number of leaves/ clump | | | | | Number of offshoots/ clump | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Kinetin | | | | Mean | Kinetin | | | | Mean |
| | | 0.0 | 25 ppm | 50 ppm | 75 ppm | | 0.0 | 25 ppm | 50 ppm | 75 ppm | |
| | | First season 2012/2013 | | | | | | | | | |
| Fertilization | 0.0 | 16.7 | 18.5 | 19.2 | 20.3 | 18.67 | 2.92 | 3.27 | 3.45 | 3.67 | 3.32 |
| | 2g/L | 18.3 | 19.7 | 20.3 | 21.9 | 20.05 | 3.21 | 3.45 | 3.63 | 3.91 | 3.55 |
| | 4g/L | 21.2 | 23.4 | 25.9 | 21.7 | 23.05 | 3.81 | 4.18 | 4.54 | 3.90 | 4.10 |
| | 6g/L | 21.9 | 24.1 | 25.4 | 26.9 | 24.5 | 3.82 | 4.36 | 4.55 | 4.72 | 4.36 |
| Mean | | 19.5 | 21.4 | 22.7 | 22.7 | 21.5 | 3.41 | 3.81 | 4.04 | 4.05 | 3.83 |
| LSD at 5 % for | | | | | | | | | | | |
| Kinetin treatments | | 1.23 | | | | | 0.24 | | | | |
| Fertilizer treatments | | 1.23 | | | | | 0.24 | | | | |
| Interaction (kinetin X fertilizer) | | 2.46 | | | | | 0.48 | | | | |
| | | Second season 2013/2014 | | | | | | | | | |
| Fertilization | 0.0 | 14.9 | 16.1 | 18.3 | 19.3 | 17.15 | 2.71 | 2.91 | 3.27 | 3.45 | 3.08 |
| | 2g/L | 15.3 | 19.3 | 19.6 | 19.6 | 18.4 | 2.73 | 3.45 | 3.45 | 3.49 | 3.28 |
| | 4g/L | 17.7 | 18.9 | 21.4 | 21.7 | 19.92 | 3.11 | 3.44 | 3.81 | 3.82 | 3.54 |
| | 6g/L | 17.2 | 20.1 | 22.3 | 22.9 | 20.6 | 3.12 | 3.63 | 4.00 | 4.18 | 3.73 |
| Mean | | 16.2 | 18.6 | 20.4 | 20.8 | 19.00 | 2.91 | 3.35 | 3.63 | 3.73 | 3.40 |
| LSD at 5 % for | | | | | | | | | | | |
| Kinetin treatments | | 1.14 | | | | | 0.31 | | | | |
| Fertilization treatments | | 1.14 | | | | | 0.31 | | | | |
| Interaction (kinetin X fertilizer) | | 2.28 | | | | | 0.62 | | | | |

*c- Fresh and dry weights of leaves:*

It was interest to observe that there was a positive correlation between the fresh and dry weights of leaves/plant and kinetin or fertilization treatments. Hence, as the levels of kinetin or fertilization increased the fresh and dry weights of leaves in up to the maximum with high level of kinetin or fertilization in both seasons

(Table, 2). However, the heaviest fresh and dry weights of leaves/ plant were recorded by 75 ppm kinetin-sprayed plants supplemented with NPK fertilization at 6 g/ plant in both seasons.

The obtained results might be due to the role of kinetin on promoting protein synthesis, increasing cell division and enlargement (Cheema and Sharma, 1982). Moreover, these results may be explained according to the role of kinetin on promoting proteins, soluble and non-soluble sugars synthesis, or may be due to the ability of kinetin for making the treated area to act as a sink in which nutrients from other parts of the plant are drawn (Salisbury and Ross, 1974).

The aforementioned results of kinetin are in conformity with those reported by El-Malt *et al.* (2006) on *Hippeastrum vittatum,* Youssef and Ismaeil (2009) on *Clivia miniata,* Youssef and Mady (2013) on *Aspidistra elatior* and Youssef and Abd El-Aal (2014) on *Hippeastrum vittatum*. The abovementioned results of fertilization are in harmony with those attained by Parthiban and Khader (1991) on tuberose plant, Amarjeet and Godara (1995) on *Polianthes tuberosa* L., Clemens and Morton (1999) on Heliconia plant, Singh *et al.* (2002) on *Gladiolus grandiflorum,* Pal and Biswas (2005) on *Polianthes tuberosa* L., El-Malt *et al.* (2006) on *Hippeastrum vittatum*, Youssef and Goma (2007) on *Iris tingitana,* Abou-El-Ella (2007) on *Acanthus mollis*, El-Naggar and El-Nasharty (2009) on *Hippeastrum vittatum,* Abd El-All (2011) on *Aspidistra elatior* and Youssef and Abd El-Aal (2014) on *Hippeastrum vittatum*.

**Table 2:** Effect of kinetin and fertilization treatments on fresh and dry weights of leaves/clump of *Hemerocallis aurantiaca* plants during 2012/2013 and 2013/2014 seasons.

| Parameters / Treatments | | Fresh weight of leaves/clumb (g.) | | | | | Dry weight of leaves/clumb (g.) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Kinetin | | | | Mean | Kinetin | | | | Mean |
| | | 0.0 | 25 ppm | 50 ppm | 75 ppm | | 0.0 | 25 ppm | 50 ppm | 75 ppm | |
| | | First season 2012/2013 | | | | | | | | | |
| Fertilization | 0.0 | 192.3 | 181.7 | 221.8 | 230.1 | 206.4 | 24.2 | 21.7 | 26.5 | 27.6 | 25 |
| | 2g/L | 211.2 | 228.5 | 235.4 | 253.0 | 232.02 | 26.4 | 27.4 | 28.2 | 30.4 | 28.1 |
| | 4g/L | 243.8 | 273.8 | 303.8 | 249.5 | 267.7 | 30.1 | 32.7 | 36.4 | 29.8 | 32.25 |
| | 6g/L | 254.1 | 284.4 | 294.1 | 309.3 | 285.4 | 31.0 | 34.1 | 35.3 | 37.1 | 34.37 |
| Mean | | 225.3 | 242.1 | 263.7 | 260.4 | 247.88 | 27.9 | 28.9 | 31.7 | 31.2 | 29.92 |
| LSD at 5 % for | | | | | | | | | | | |
| kinetin treatments | | 12.4 | | | | | 0.82 | | | | |
| Fertilizer treatments | | 12.4 | | | | | 0.82 | | | | |
| Interaction (kinetin X fertilizer) | | 24.8 | | | | | 1.64 | | | | |
| | | Second season 2013/2014 | | | | | | | | | |
| Fertilization | 0.0 | 181.5 | 193.2 | 221.4 | 233.5 | 207.4 | 21.7 | 23.1 | 26.5 | 27.9 | 24.8 |
| | 2g/L | 182.3 | 233.5 | 239.1 | 239.4 | 223.5 | 21.9 | 27.9 | 28.6 | 28.6 | 26.7 |
| | 4g/L | 212.4 | 230.6 | 263.3 | 269.1 | 243.85 | 25.4 | 27.6 | 31.5 | 32.3 | 29.2 |
| | 6g/L | 208.2 | 249.2 | 276.5 | 286.3 | 255.05 | 24.9 | 29.8 | 33.1 | 34.3 | 30.52 |
| | Mean | 196.1 | 226.6 | 250.0 | 257.0 | 232.4 | 23.4 | 27.1 | 29.9 | 30.8 | 27.8 |
| LSD at 5 % for | | | | | | | | | | | |
| Kinetin treatments | | 21.3 | | | | | 3.21 | | | | |
| Fertilization treatments | | 21.3 | | | | | 3.21 | | | | |
| Interaction (kinetin X fertilizer) | | 42.6 | | | | | 6.42 | | | | |

**2- Flowering growth parameters:**

*a- Flowering start:*

Table (3) illustrates that all tested kinetin and applied fertilization treatments as well as their interaction induced earlier flowering as compared with untreated control with significant differences in both seasons. However, the earlier flowering (241 and 254 days) was gained by 75 ppm kinetin – sprayed plants provided with NPK fertilization at 4 g / plant, in the first and second seasons, respectively.

*b- Number of flowers/clump:*

Data presented in Table (3) declare that the number of flower/clump was increased as the concentration of kinetin increased. Consequently 75 ppm kinetin - sprayed plants recorded the highest values of this parameter in both seasons. Paralley, the number of flower/clump increased with all tested levels of NPK fertilization, especially the high level in seasons.

In general, all interaction between kinetin and NPK fertilization treatments succeeded in increasing the number of flower/clump as compared with control in the two seasons. However, the highest number of flower/clump (3.72 and 3.51) was scored by 75 ppm kinetin-sprayed plants enriched with NPK fertilization at 6g/plant in the first and second seasons, respectively.

*c- Length and diameter of flower stalk (cm):*

It was found that the length and diameter of flower stalk are proportionally were increased with the increment of kinetin or NPK fertilization level in most cases (Table, 4). Therefore, the high and medium level of kinetin or fertilization significantly recorded the highest values in this respect as compared with untreated plants in both seasons. Generally, all resulted combinations of kinetin and NPK fertilization statistically increased the values of these parameters as compared with control in the two seasons. However, 75 ppm kinetin- sprayed plants joined with NPK fertilization at 6 or 4 g/plant induced the highest values in this concern in the two assigned seasons.

**Table 3:** Effect of kinetin and fertilization treatments on flowering start and number of flowers/clump of *Hemerocallis aurantiaca* plants during 2012/2013 and 2013/2014seasons.

| Parameters / Treatments | | Flowering start days | | | | | Number of flowers/clump | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Kinetin | | | | Mean | Kinetin | | | | Mean |
| | | 0.0 | 25 ppm | 50 ppm | 75 ppm | | 0.0 | 25 ppm | 50 ppm | 75 ppm | |
| | | First season 2012/2013 | | | | | | | | | |
| Fertilization | 0.0 | 274 | 268 | 263 | 261 | 266 | 2.21 | 2.48 | 2.65 | 2.83 | 2.54 |
| | 2g/L | 261 | 254 | 252 | 249 | 254 | 2.43 | 2.61 | 2.80 | 3.04 | 2.72 |
| | 4g/L | 254 | 251 | 247 | 241 | 248 | 2.92 | 2.27 | 3.54 | 3.08 | 3.20 |
| | 6g/L | 259 | 252 | 249 | 245 | 251 | 2.6 | 3.40 | 3.55 | 3.72 | 3.40 |
| Mean | | 262 | 256 | 252 | 249 | 254 | 2.63 | 2.94 | 3.13 | 3.16 | 2.96 |
| LSD at 5 % for | | | | | | | | | | | |
| kinetin treatments | | 5.11 | | | | | 0.23 | | | | |
| Fertilizer treatments | | 5.11 | | | | | 0.23 | | | | |
| Interaction (kinetin X fertilizer) | | 10.22 | | | | | 0.46 | | | | |
| | | Second season 2013/2014 | | | | | | | | | |
| Fertilization | 0.0 | 283 | 276 | 272 | 267 | 274 | 2.14 | 2.34 | 2.68 | 2.83 | 2.49 |
| | 2g/L | 279 | 271 | 269 | 262 | 270 | 2.16 | 2.82 | 2.82 | 2.89 | 2.67 |
| | 4g/L | 268 | 272 | 258 | 254 | 263 | 2.46 | 2.82 | 3.15 | 3.15 | 2.89 |
| | 6g/L | 274 | 271 | 264 | 259 | 267 | 2.51 | 4.37 | 3.32 | 3.51 | 3.42 |
| | Mean | 276 | 272 | 265 | 260 | 268 | 2.31 | 3.08 | 2.99 | 3.09 | 2.86 |
| LSD at 5 % for | | | | | | | | | | | |
| Kinetin treatments | | 4.34 | | | | | 5.24 | | | | |
| Fertilization treatments | | 4.34 | | | | | 5.24 | | | | |
| Interaction (kinetin X fertilizer) | | 8.68 | | | | | 10.48 | | | | |

**Table 4:** Effect of kinetin and fertilization treatments on length and diameter of flower stalk of *Hemerocallis aurantiaca* plants during 2012/2013 and 2013/2014 seasons.

| Parameters / Treatments | | Flower stalk length | | | | | Flower stalk diameter | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Kinetin | | | | Mean | Kinetin | | | | Mean |
| | | 0.0 | 25 ppm | 50 ppm | 75 ppm | | 0.0 | 25 ppm | 50 ppm | 75 ppm | |
| | | First season 2012/2013 | | | | | | | | | |
| Fertilization | 0.0 | 82.3 | 83.4 | 85.1 | 88.2 | 84.7 | 1.16 | 1.24 | 1.29 | 1.37 | 1.26 |
| | 2g/L | 84.1 | 85.2 | 86.4 | 89.7 | 86.3 | 1.21 | 1.27 | 1.36 | 1.41 | 1.31 |
| | 4g/L | 86.3 | 86.9 | 89.0 | 92.6 | 88.9 | 1.32 | 1.34 | 1.35 | 1.49 | 1.37 |
| | 6g/L | 87.6 | 88.2 | 89.6 | 94.5 | 89.9 | 1.29 | 1.31 | 1.39 | 1.45 | 1.36 |
| Mean | | 85.07 | 85.9 | 87.5 | 91.28 | 87.4 | 1.24 | 1.29 | 1.34 | 1.43 | 1.32 |
| LSD at 5 % for | | | | | | | | | | | |
| kinetin treatments | | 2.11 | | | | | 0.07 | | | | |
| Fertilizer treatments | | 2.11 | | | | | 0.07 | | | | |
| Interaction (kinetin X fertilizer) | | 4.22 | | | | | 0.14 | | | | |
| | | Second season 2013/2014 | | | | | | | | | |
| Fertilization | 0.0 | 87.8 | 89.5 | 91.1 | 92.6 | 90.2 | 1.19 | 1.25 | 1.32 | 1.39 | 1.28 |
| | 2g/L | 89.4 | 91.3 | 92.4 | 94.3 | 91.8 | 1.23 | 1.37 | 1.36 | 1.43 | 1.34 |
| | 4g/L | 88.3 | 93.4 | 94.5 | 96.4 | 93.1 | 1.29 | 1.36 | 1.42 | 1.52 | 1.39 |
| | 6g/L | 91.2 | 92.9 | 95.6 | 97.8 | 94.3 | 1.31 | 1.35 | 1.37 | 1.49 | 1.38 |
| | Mean | 89.1 | 91.7 | 93.4 | 95.2 | 92.3 | 1.25 | 1.33 | 1.36 | 1.45 | 1.34 |
| LSD at 5 % for | | | | | | | | | | | |
| Kinetin treatments | | 3.25 | | | | | 0.08 | | | | |
| Fertilization treatments | | 3.25 | | | | | 0.08 | | | | |
| Interaction (kinetin X fertilizer) | | 6.50 | | | | | 0.16 | | | | |

*d- Fresh and dry weights of flower (g):*

Data presented in Table (5) reported that fresh and dry weights of flower increased as the concentration of kinetin increased. Consequently 75 ppm kinetin - sprayed plants recorded the heaviest fresh and dry weights of flower in both seasons. Paralley, the fresh dry weights of flower/clump was increased with all tested levels of NPK fertilization, especially the high level in both seasons.

Generally, all interactions between kinetin and NPK fertilization treatments succeeded in increasing the fresh and dry weights of flowers as compared with control in the two seasons. However, the heaviest fresh and dry weights of flower were scored by 75 ppm kinetin-sprayed plants fertilized with NPK fertilization at 6g/plant in the first and second seasons, respectively.

**Table 5:** Effect of kinetin and fertilization treatments on fresh and dry weights of flower *of Hemerocallis aurantiaca* plants during 2012/2013 and 2013/2014 seasons.

| Parameters / Treatments | | Fresh weight of flower (g.) | | | | | Dry weight of flower(g.) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Kinetin | | | | Mean | Kinetin | | | | Mean |
| | | 0.0 | 25 ppm | 50 ppm | 75 ppm | | 0.0 | 25 ppm | 50 ppm | 75 ppm | |
| | | First season 2012/2013 | | | | | | | | | |
| Fertilization | 0.0 | 73.2 | 101.7 | 102.0 | 95.6 | 95.6 | 7.83 | 12.12 | 12.24 | 12.60 | 11.19 |
| | 2g/L | 100.8 | 102.0 | 103.7 | 107.6 | 103.5 | 12.11 | 12.24 | 12.36 | 12.84 | 12.38 |
| | 4g/L | 103.2 | 104.4 | 106.8 | 111.1 | 106.3 | 12.36 | 12.48 | 12.72 | 12.33 | 12.72 |
| | 6g/L | 105.2 | 105.6 | 107.3 | 113.4 | 107.8 | 12.60 | 12.65 | 12.84 | 13.61 | 12.92 |
| Mean | | 95.6 | 103.4 | 104.9 | 109.4 | 103.3 | 11.2 | 12.37 | 12.54 | 13.09 | 12.30 |
| LSD at 5 % for | | | | | | | | | | | |
| Kinetin treatments | | 7.34 | | | | | 1.12 | | | | |
| Fertilizer treatments | | 7.34 | | | | | 1.12 | | | | |
| Interaction (kinetin X fertilizer) | | 14.68 | | | | | 2.24 | | | | |
| | | Second season 2013/2014 | | | | | | | | | |
| Fertilization | 0.0 | 78.1 | 97.9 | 100.1 | 101.6 | 94.4 | 8.87 | 11.76 | 12.01 | 12.12 | 11.19 |
| | 2g/L | 92.4 | 100.1 | 101.2 | 103.4 | 99.2 | 11.04 | 12.00 | 12.12 | 12.37 | 11.88 |
| | 4g/L | 94.6 | 102.3 | 103.4 | 105.6 | 101.4 | 11.28 | 12.24 | 12.36 | 12.61 | 12.12 |
| | 6g/L | 95.7 | 102.2 | 104.5 | 107.8 | 102.5 | 11.40 | 12.24 | 12.48 | 12.84 | 12.24 |
| | Mean | 90.2 | 100.6 | 102.3 | 104.6 | 99.4 | 10.64 | 12.06 | 12.24 | 12.48 | 11.85 |
| LSD at 5 % for | | | | | | | | | | | |
| Kinetin treatments | | 8.26 | | | | | 1.43 | | | | |
| Fertilization treatments | | 8.26 | | | | | 1.43 | | | | |
| Interaction (kinetin X fertilizer) | | 16.54 | | | | | 2.86 | | | | |

*e- Duration of flower on plant and flower vase life (days):*

Data in Table (6) indicated that all tested kinetin concentrations slightly increased duration of flower on plant and flower vase life, especially the high concentration in both seasons. Likewise, the three studied levels of NPK fertilizer resulted in slight increments in these parameters. Meanwhile, 6g/plant NPK -fertilized plants showed to be the most effective level to induce the highest duration of flower on plant and flower vase life as compared with other levels or control in both seasons. Generally, all combinations between kinetin and NPK treatments prolonged the duration of flower on plant and flower vase life "days" in both seasons as compared with control. However, the highest mean values of duration of flower on plant and flower vase life were scored by using the combined treatment between kinetin at 75 ppm and NPK fertilizer at 6 g/plant when compared with control and other combinations in both seasons.

The obtained results might be due to the role of kinetin on promoting protein synthesis, increasing cell division, enlargement and chlorophyll synthesis (Cheema and Sharma, 1982). Moreover, these results might be explained according to the role of kinetin on promoting proteins, soluble and non-soluble sugars synthesis, or may be due to the ability of kinetin for making the treated area to act as a sink in which nutrients from other parts of the plant are drawn (Salisbury and Ross, 1974).

The aforementioned results of kinetin are in conformity with those reported by Runkova (1985) on *Dhalia pinnata*, Auda (1992) on *Hippeastrum vittatum*, Maximoos (1993) on *Gerbera jamesonii* , El-Malt *et al.* (2006) on *Hippeastrum vittatum,* Youssef and Ismaeil (2009) on *Clivia miniata* and Youssef and Abd El-Aal (2014) on *Hippeastrum vittatum*. The abovementioned results of fertilization are in harmony with those attained by Parthiban and Khader (1991) on tuberose plant, Amarjeet and Godara (1995) on *Polianthes tuberosa* L. plant, Clemens and Morton (1999) on Heliconia plant, Khalafalla *et al*. (2000) on *Ornithogalum thyrosoides*, Singh *et al.* (2002) on *Gladiolus grandiflorum,* Pal and Biswas (2005) on *Polianthes tuberosa* L., El-Malt *et al*. (2006) on *Hippeastrum vittatum,* Youssef and Goma (2007) on *Iris tingitana,* Abou-El-Ella (2007) on *Acanthus mollis*, El-Naggar and El-Nasharty (2009) on *Hippeastrum vittatum* and Youssef and Abd El-Aal (2014) on *Hippeastrum vittatum.*

**3-Chemical constituents:**

*a- Leaf N, P and K content (%):*

Data in Tables (7 and 8) showed that all tested treatments of kinetin, fertilization and their combinations succeeded in increasing leaf N, P and K contents as compared with control in both seasons. However, the highest leaf N content (1.65 and 1.72%) was recorded by 75 ppm kinetin- sprayed plants provided with NPK fertilization at 6 g/ plant in the first and second seasons, respectively. Also, the richest leaf P content (0.169 and

0.168 %) was registered by 75ppm kinetin –sprayed plants combined with NPK fertilization at 6g/plant in first and second seasons, respectively. While, the greatest leaf K content (2.59 and 2.43%) was scored by 75 ppm kinetin-sprayed plants supplemented with NPK at 4 g/plant in first and second seasons, respectively.

**Table 6:** Effect of kinetin and fertilization treatments on duration of flower on plant and flower vase life of *Hemerocallis aurantiaca* plants during 2012/2013 and 2013/2014seasons.

| Parameters / Treatments | | Duration of flower on plant (days) | | | | | Flower vase life (days) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Kinetin | | | | Mean | Kinetin | | | | Mean |
| | | 0.0 | 25 ppm | 50 ppm | 75 ppm | | 0.0 | 25 ppm | 50 ppm | 75 ppm | |
| | | First season 2012/2013 | | | | | | | | | |
| Fertilization | 0.0 | 8.7 | 9.4 | 10.8 | 11.4 | 10.07 | 5.97 | 6.18 | 7.04 | 7.39 | 6.64 |
| | 2g/L | 9.2 | 10.6 | 11.3 | 11.8 | 10.7 | 6.11 | 6.81 | 7.31 | 7.92 | 7.03 |
| | 4g/L | 10.6 | 10.5 | 11.9 | 12.5 | 11.3 | 6.29 | 7.21 | 7.28 | 8.14 | 7.23 |
| | 6g/L | 10.2 | 11.3 | 12.4 | 12.9 | 11.7 | 6.26 | 7.19 | 7.31 | 8.20 | 7.24 |
| Mean | | 9.6 | 10.4 | 11.6 | 12.1 | 10.9 | 6.15 | 6.84 | 7.23 | 7.91 | 7.03 |
| LSD at 5 % for | | | | | | | | | | | |
| Kinetin treatments | | 3.27 | | | | | 0.73 | | | | |
| Fertilizer treatments | | 3.27 | | | | | 0.73 | | | | |
| Interaction (kinetin X fertilizer) | | 6.54 | | | | | 1.46 | | | | |
| | | Second season 2013/2014 | | | | | | | | | |
| Fertilization | 0.0 | 9.3 | 10.6 | 11.5 | 12.1 | 10.8 | 6.38 | 7.12 | 7.39 | 7.51 | 7.1 |
| | 2g/L | 10.4 | 11.3 | 11.8 | 12.3 | 11.4 | 7.02 | 7.31 | 7.42 | 7.92 | 7.41 |
| | 4g/L | 10.2 | 12.4 | 12.8 | 12.9 | 12.07 | 7.34 | 7.28 | 7.64 | 8.49 | 7.68 |
| | 6g/L | 10.9 | 12.1 | 12.7 | 13.2 | 12.2 | 7.68 | 7.91 | 8.41 | 8.76 | 8.19 |
| | Mean | 10.2 | 11.6 | 12.2 | 12.6 | 11.65 | 7.10 | 7.40 | 7.71 | 8.17 | 7.59 |
| LSD at 5 % for | | | | | | | | | | | |
| Kinetin treatments | | 1.36 | | | | | 0.57 | | | | |
| Fertilization treatments | | 1.36 | | | | | 0.57 | | | | |
| Interaction (kinetin X fertilizer) | | 2.72 | | | | | 1.14 | | | | |

**Table 7:** Effect of kinetin and fertilization treatments on leaf nitrogen and phosphorus content (%) of *Hemerocallis aurantiaca* plants during 2012/2013 and 2013/2014seasons.

| Parameters / Treatments | | N% | | | | | P% | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Kinetin | | | | Mean | Kinetin | | | | Mean |
| | | 0.0 | 25 ppm | 50 ppm | 75 ppm | | 0.0 | 25 ppm | 50 ppm | 75 ppm | |
| | | First season 2012/2013 | | | | | | | | | |
| Fertilization | 0.0 | 1.29 | 1.38 | 1.43 | 1.52 | 1.40 | 0.129 | 0.135 | 0.144 | 0.153 | 0.140 |
| | 2g/L | 1.36 | 1.41 | 1.49 | 1.63 | 1.47 | 0.134 | 0.139 | 0.149 | 0.162 | 0.146 |
| | 4g/L | 1.34 | 1.49 | 1.52 | 1.61 | 1.49 | 0.132 | 0.148 | 0.147 | 0.161 | 0.147 |
| | 6g/L | 1.41 | 1.46 | 1.56 | 1.65 | 1.52 | 0.139 | 0.145 | 0.153 | 0.169 | 0.151 |
| Mean | | 1.35 | 1.44 | 1.5 | 1.60 | 1.47 | 0.133 | 0.141 | 0.148 | 0.161 | 0.146 |
| LSD at 5 % for | | | | | | | | | | | |
| kinetin treatments | | 0.12 | | | | | 0.011 | | | | |
| Fertilizer treatments | | 0.12 | | | | | 0.011 | | | | |
| Interaction (kinetin X fertilizer) | | 0.24 | | | | | 0.022 | | | | |
| | | Second season 2013/2014 | | | | | | | | | |
| Fertilization | 0.0 | 1.22 | 1.37 | 1.49 | 1.57 | 1.41 | 0.132 | 0.137 | 0.143 | 0.151 | 0.140 |
| | 2g/L | 1.34 | 1.46 | 1.53 | 1.68 | 1.50 | 0.136 | 0.141 | 0.149 | 0.159 | 0.146 |
| | 4g/L | 1.39 | 1.43 | 1.56 | 1.69 | 1.51 | 0.146 | 0.149 | 0.147 | 0164 | 0.151 |
| | 6g/L | 1.48 | 1.49 | 1.64 | 1.72 | 1.58 | 0.142 | 0.147 | 0.153 | 0.168 | 0.152 |
| | Mean | 1.36 | 1.43 | 1.55 | 1.66 | 1.5 | 0.139 | 0.143 | 0.148 | 0.160 | 0.147 |
| | | | | | | | | | | | |
| LSD at 5 % for | | | | | | | | | | | |
| Kinetin treatments | | 0.13 | | | | | 0.013 | | | | |
| Fertilization treatments | | 0.13 | | | | | 0.013 | | | | |
| Interaction (kinetin X fertilizer) | | 0.26 | | | | | 0.026 | | | | |

*b- Leaf total carbohydrates content (%):*

Table (8) indicates that all tested fertilization levels increased leaf total carbohydrates content as compared with un-treated plants in both seasons. Also, the increment of leaf total carbohydrates content was in parallel to the increasing of kinetin concentration to reach its maximum increase at the high concentration in both seasons. In general, all resulted interactions between kinetin and fertilization treatments statistically increased the values of this parameter as compared with control in both seasons. However, the highest values of leaf total carbohydrates (15.32 and 16.92%) content was recorded by 75 ppm kinetin-sprayed plants supplemented with NPK fertilization at 4 g/plant, in the first and second seasons, respectively.

As for the explanation of the incremental effect of kinetin on chemical constituents of *Hemerocallis aurantiaca* content, it could be illustrated here on the basis that kinetin treatments stimulated the endogenous cytokinins synthesis as will be mentioned afterwards and there is an intimate relationship between cytokinins and chlorophylls metabolism in both excided or detached leaf disks and intact plants i.e., cytokinins retard chlorophylls degradation, preserve it and increase its synthesis (Devlin and Witham, 1983). Besides, cytokinins activate a number of enzymes participating in a wide range of metabolic reactions in the leaves. These reactions included the maturation of proplastids into chloroplasts. These enzymes could be divided into two groups according to their response to cytokinins. The first group of enzymes could be said to relate to chloroplast differentiation, while the second one could be related to cytokinin stimulated group (Kulaeva, 1979). Also, these results may explain the role of cytokinins on promoting proteins and pigments synthesis and their ability to delay senescence and withdraw sugars and other solutes from older parts of a plant to the new organs (Salisbury and Ross, 1974). In the same line, Leopol and Kawase, (1964) stated that cytokinins stimulate the movement of sugars, starch, amino acids and many other solutes from mature organs to primary tissues of other ones. Furthermore, it may be due to the role of kinetin on increasing the growth promoters in the plant tissues at the expense of the inhibitors. In this concern, Kenneth, (1979) reported that total control of plant growth is vested not in a single hormonal type – that of auxin – but is shared by several specially auxins, cytokinins, gibberellins and ethylene and this further subjected to namely the phenols, flavons and absicsic acid. The stimulated effect of fertilization treatments may be due to the role of mineral fertilization 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 the plants (Marschner, 1997).

The aforementioned results of kinetin are in conformity with those obtained by Maximoos (1993) on *Gerbera jamesonii*, Shahin (1998) on Crinum and Hemerocallis plants, El-Malt *et al.* (2006) on *Hippeastrum vittatum,* Youssef and Ismaeil (2009) on *Clivia miniata,* Youssef and Mady (2013) on *Aspidistra elatior* and Youssef and Abd El-Aal (2014) on *Hippeastrum vittatum.*

The abovementioned results of fertilization are in harmony with those attained by Parthiban and Khader (1991) on tuberose plant, EL-Naggar, (1994) on *Gladiolus* hybrid, Amarjeet and Godara (1995) on *Polianthes tuberosa* L., Clemens and Morton, (1999) on Heliconia plant, Khalafalla *et al*. (2000) on *Ornithogalum thyrosoides*, Atta-Alla and Zaghloul, (2002) on *Iris tingitana*, Pal and Biswas, (2005) on *Polianthes tuberosa* L., El-Malt *et al*. (2006) on *Hippeastrum vittatum*, Youssef and Goma (2007) on *Iris tingitana,* Abou-El-Ella, (2007) on *Acanthus mollis*, El-Naggar and El-Nasharty, (2009) on *Hippeastrum vittatum,* Abd El-All, (2011) on *Aspidistra elatior* and Youssef and Abd El-Aal, (2014) on *Hippeastrum vittatum.*

**Table 8:** Effect of kinetin and fertilization treatments on leaf potassium and total carbohydates content (%) of *Hemerocallis aurantiaca* plants during 2012/2013 and 2013/2014seasons.

| Parameters / Treatments | | K% | | | | | Total carbohydrates% | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Kinetin | | | | Mean | Kinetin | | | | Mean |
| | | 0.0 | 25 ppm | 50 ppm | 75 ppm | | 0.0 | 25 ppm | 50 ppm | 75 ppm | |
| | | First season 2012/2013 | | | | | | | | | |
| fertilization | 0.0 | 1.84 | 1.96 | 2.19 | 2.31 | 2.07 | 10.21 | 11.39 | 12.42 | 12.92 | 11.73 |
| | 2g/L | 1.93 | 2.16 | 2.28 | 2.41 | 2.19 | 11.31 | 12.94 | 13.81 | 13.41 | 12.86 |
| | 4g/L | 2.09 | 2.29 | 2.39 | 2.59 | 2.34 | 12.94 | 13.21 | 13.78 | 15.32 | 13.81 |
| | 6g/L | 2.04 | 2.28 | 2.37 | 2.53 | 2.30 | 12.13 | 13.11 | 13.64 | 14.16 | 13.26 |
| Mean | | 1.97 | 2.17 | 2.30 | 2.46 | 2.22 | 11.64 | 12.66 | 13.41 | 13.95 | 12.91 |
| LSD at 5 % for | | | | | | | | | | | |
| Kinetin treatments | | 0.21 | | | | | 1.32 | | | | |
| Fertilizer treatments | | 0.21 | | | | | 1.32 | | | | |
| Interaction (kinetin X fertilizer) | | 0.42 | | | | | 1.64 | | | | |
| | | Second season 2013/2014 | | | | | | | | | |
| fertilization | 0.0 | 1.62 | 1.78 | 1.98 | 2.16 | 1.88 | 10.07 | 12.04 | 13.21 | 14.81 | 15.53 |
| | 2g/L | 1.73 | 1.96 | 2.19 | 2.26 | 2.03 | 11.92 | 12.91 | 14.79 | 15.62 | 13.81 |
| | 4g/L | 1.94 | 2.21 | 2.27 | 2.43 | 2.21 | 12.83 | 13.81 | 14.64 | 16.92 | 14.55 |
| | 6g/L | 1.91 | 2.11 | 2.23 | 2.37 | 2.15 | 12.37 | 12.76 | 14.61 | 16.34 | 14.02 |
| | Mean | 1.8 | 2.01 | 2.16 | 2.30 | 2.06 | 11.79 | 12.88 | 14.31 | 15.92 | 13.72 |
| LSD at 5 % for | | | | | | | | | | | |
| Kinetin treatments | | 0.24 | | | | | 1.41 | | | | |
| Fertilization treatments | | 0.24 | | | | | 1.41 | | | | |
| Interaction (kinetin X fertilizer) | | 0.48 | | | | | 2.82 | | | | |

Conclusively, in order to produce good quality *Hemerocallis aurantiaca* plants, it is preferable to spray the plants with kinetin at 50or 75ppm three times supplemented with mineral fertilization at 4 or 6g/plant six times a year**.**

## References

Abd El-All, S.G., 2011. Response of cast-iron plant (*Aspidistra elatior* Blume) to foliar nutrition with greenzit and $GA_3$. M.Sc. Thesis, Fac. Agric., Benha Univ.

Abou El-Ella, E.M., 2007. Physiological studies on *Acanthus mollis* plant. M.Sc., Thesis, Hort. Dept. Fac. Agric., Benha Univ.

Amarjeet, S. and N.R. Godara, 1995. Studies on the nutritional requirement of tuberose (*Polianthes tuberosa* L.) cv. Single during growth. Haryana Agric. Univ. J. Res., 25(4): 171-174.

Atta-Alla, H.K. and M. Zaghloul, 2002. Effect of cold storage, $GA_3$ and fertilization on the growth, flowering and chemical composition of *Iris tingitana* cv. Wedgwood. J. Agric. Sci. Mansoura Univ., 27 (9): 6267-6285.

Auda, M.S., 1992. Physiological studies on Amaryllis bulbs. Ph.D. Thesis, Fac. Agric., Ain Shams Univ. Egypt.

Bose, T.K. and L.P. Yadav, 1989. Commercial Flowers. B. Mitra-NAY PROKASH, 206 Bidhay Sarani, Calcotta 700006, India. PP. 894

Brown, J.D. and O. Lilleland, 1946. Rapid determination of potassium and sodium in plant material and soil extract by flame photometry. Proc. Amer. Soc., Hort., Sci., 48:341-346.

Cheema, G.S. and D.P. Sharma, 1982. In vitro propagation of apple rootstocks. Int. Hort. Congr XXI. Hamburg, German Federal Republic, Int. Soc. Hort. Sci. Vol. 1: 1035 (Chem. Abst., 52: 7692).

Clemens, J. and R.H. Morton, 1999. Optimizing mineral nutrition for flower production in Heliconia Golden Torch' using response surface methodology. J. Amer. Soc. Hort. Sci., 124(6): 713-718.

Devlin, M. and H. Witham, 1983. Plant Physiology, 4th Ed. Publishers Willard, Grant Press, Boston.

El-Malt, A.A.T., E.E. El-Maadawy, M.A. El-Khateeb and Z.H. El-Sadak, 2006. Physiological studies on *Hippeastrum vittatum* L. plants.2- Effect of NPK, CCC and BA on growth, bulblet production and flowering. Egypt.J. of Appl. Sci., (6B): 724-742.

El-Naggar, A.H. and A.B. El-Nasharty, 2009. Effect of growing media and mineral fertilization on growth, flowering, bulbs productivity and chemical constituents of *Hippeastrum vittatum*, Herb. American-Eurasian J. Agric. & Environ. Sci., 6 (3): 360-371.

El-Naggar, A.H.M., 1994. Effect of different ratios and levels of some fertilizer on the vegetative growth, flowering and corms production of gladiolus. M.Sc. Thesis, Alex. Univ., Egypt.

Herbert, D., P.J. Phipps and R.E. Strange, 1971. Determination of total carbohydrates, Methods in Microbiology, 5 (8): 290-344.

Johanson, D. A., 1940. Plant Microtechnique (5th edition) MC. Grow Hill, Book, Company. New York,

Kenneth, V.T., 1979. Physiology of Plant Growth and Development. Nalcolm. B. Wilkins TATA McGraw-Hill Publishing Co. Ltd. New-Delhi.

Khalafalla, M., E. Mahrouk, E. Nofal, A. Nabih and S. Goma, 2000. Effect of growing medium and chemical fertilization on growth, flowering, bulb productivity and chemical constituents of *Ornithogalum thyrosoides* Jacq. Hort. Dept. Agric. Fac. Tanta Univ. Hort. Res. Inst. Agric. Res. Center. Egypt.

Kulaeva, O.N., 1979. Cytokinin action on enzyme activities in plants. In plant growth substances. (Ed.) F. Skoog, Springer-verlage Berlin, Heidelberg. New York (1980), pp. 119-128.

Leopol, A.C. and M. Kawase, 1964. Senescence of a trifoliate bean leaf caused by treating the primary leaves of cuttings with benzyladenine. Amer. J. Bot., 51: 294-298.

Marschner, H., 1997. Mineral Nutrition of Higher plants. Second Printing, Academic press INC. San Diego, pp: 889.

Maximoos, S.L., 1993. Physiological and hormonal studies on the growth and flowering of Gerbera Plant. Ph.D. Thesis, Fac. Agric., Ain Shams Univ.

Oganezova, G.G., 1990. Characteristics of the anatomical structure of seeds of some Amaryllidaceae in connection with their systematic and phylogeny. Botanicheskii Zhurnal 75(5): 615-630 USSR (C.F. Hort. Abst., 61(3):2153).

Pal, A.K. and B. Biswas, 2005. Response of fertilizer on growth and yield of tuberose (*Polianthes tuberosa* L.) cv. Calacutta Single in the plains of Wast Bengle. J. Interacademicia, Nadia, India, 9(1): 33-36.

Parthiban, S. and M.A. Khader, 1991. Effect of NP and K on yield components and yield in tuberose. South Indian Horti., 39(6): 363-367.

Pregl, F., 1945. Quantitative organic micro analysis. 4th ED. J. & Achurnil, London. Regul., 4: 111-122.

Rees, A.R., 1992. Ornamental bulbs, Corms and Tubers. C.A.B. Inter., Wallingford, UK. 61-65.

Runkova, L.V. (1985): Cytokinin's effect on some ornamental plants. Acta-Horticulturae. 1985, No. 167, 69-77; 12 ref.

Salisbury, F.B. and C.W. Ross, 1974. Plant Physiology. Publishing Inc. Belmont. California, 2nd ed., pp. 422.

Shahin, S.M.E., 1998. Physiological studies on Crinum and Hemerocallis bulbs. Ph.D. Thesis, Fac. Agric., Tanta Univ.

Singh, W., S.K. Sehrawat, D.S. Dahiya and K. Singh, 2002. Leaf nutrient status of gladiolus (*Gladiolus grandiflorus* L.) cv. Sylvia as affected by NPK application. Haryana Journal of Horticultural Sciences, Horticultural Society of Haryana, Hisar, India, 31(1/2): 49-51.

Snedecor, G.W. and W.G. Cochran, 1989. Statistical methods. 7th Ed. Iowa State Univ. Press. Ames Iowa, USA.

Trouge, E. and A.H. Meyer, 1939. Improvement in deiness calorimetric for phosphorus and arsenic. Ind. Eng. Chem. Anal. Ed., 1; 136-139.

Youssef, A.S.M. and A.O. Gomaa, 2007. Effect of some horticultural treatments on growth, flowering, bulb production and chemical composition of *Iris tingitana* cv. Wedgwood. The Third Conf. of Sustain. Agric. and Develop. Fac. of Agric., Fayoum Univ., 12-14 Nov.

Youssef, A.S.M and F.H.M. Ismaeil, 2009. Response of Clivia miniata plant to light intensity and kinetin treatments. Annals of Agric. Sc., Moshtohor, Vol. 47(1): Ho. 149-164.

Youssef, A.S.M. and M.A. Mady, 2013. Influence of light intensity and benzyladenine on growth performance of *Aspidistra elatior* Blume plant. Research Journal of Agriculture and Biological Sciences, 9(5): 248-257.

Youssef, A.S.M. and M.M.M. Abd El-Aal, 2014. Effect of kinetin and mineral fertilization on growth, flowering, bulbs productivity, chemical compositions and histological features of *Hippeastrum vittatum* plant. J. Plant Production, Mansoura Univ., Vol. 5 (3): 357 – 381.