INFLUENCE OF ORGANIC MANURE, BIOFERTILIZER AND/OR SOME VITAMIN TREATMENTS ON:
A. VEGETATIVE GROWTH AND FLOWERING ASPECTS OF
GLADIOLUS GRANDIFLORUS VAR. GOLD FIELD PLANTS

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ABSTRACT: A field experiment was carried out during the two successive seasons of 2016/2017 and 2017/2018. The aim of this study was to investigate the effect of farmyard manure (FYM) at four levels (0, 10, 15 and 20 m³/fed) in combination with Minia Azotein (M.A.) at 50 ml/plant and/or some vitamins (E and C) each at 50 ppm, in addition to the control on vegetative growth and flowering of Gladiolus grandiflorus var. Gold Field plants. Results showed that leaf length (cm), number of leaves/plant, leaves dry weight/plant (g), length of spike (cm), spike diameter (mm), spike fresh weight (g), number of florets/spike, lower floret diameter (cm) and lower floret fresh weight (g) were gradually increased by increasing the levels of farmyard manure with significant differences were detected between successive treatments. Also, Minia Azotein (M.A.) and/or some vitamins (E and C) treatments significantly increased all vegetative growth and flowering parameters in comparison with the control. Minia Azotein (M.A.) plus vitamins E and vitamin C were more effective in this concern. It was found also that the use of FYM (20 m³/fed) in combination with Minia Azotein (M.A.) plus vit. E and vit. C followed by 20 m³/fed FYM with M.A. + vit. C then 15 m³/fed FYM with M.A. + vit. E + vit. C noticeably improved the different vegetative growth and flowering parameters of gladiolus plants.

Key words: Gladiolus grandifloras, farmyard manure, biofertilizers, vitamins, vegetative growth, flowering.

INTRODUCTION

Gladiolus grandiflorus, L. is derived from the native plants of south and central Africa, as well as, the Mediterranean region (De-Hertogh and Le Nard, 1995). Gladiolus (Family Iridaceae) is a valuable and economic flowering bulb plant used as a landscape plant in the home gardens and in decoration as a lovely and rich colored cut flower spike with relatively long vase life (Hogan, 1990). In this study corms of Gladiolus grandiflorus var. Gold Field were chosen for their adaptability to the Egyptian environmental conditions, besides the possibility of exporting of its flowers for the demand increased.

Organic, Minia Azotein (M.A.) biofertilizer and some vitamins (E and C) are among the important agricultural treatments which have been proved to improve the vegetative growth and flowering aspects of gladiolus plants.

Many investigators revealed the importance of organic fertilization on the growth and flowering of gladiolus such as Gajbhiye et al. (2013), Khalil (2015), Tirkey et al. (2017), Abdou et al. (2018) and Pal and Singh (2019) on gladiolus plants, Poursafarali et al. (2011), Srivastava et al.
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(2014) and Karim et al. (2017) on tuberose plant, Mirkalae et al. (2013) and Prasad et al. (2017) on Lilium spp. and Bostan et al. (2014) on Amaryllus belladonna.

The role of Minia Azotein (M.A.) biofertilizer in improving vegetative growth and flowering parameters was revealed by Abdou et al. (2004), Hassanein and El-Sayed (2009), Kashyap (2016) and Bohra and Nautiyal (2019) on gladiolus, El-Naggar and Mahmoud (1994) on narcissus plants, Abdou (2004 a) and Abdou (2004 b) on Dahlia pinnata.

The role of alpha tocopherols (vit. E) in improving vegetative growth and flowering characters was also mentioned by Hussein et al. (2007) on cowpea, El-Lethy et al. (2010) on flax and Mohamed (2016) on Antirrhinum majus plants.

The role of ascorbic acid (vit. C) in improving vegetative growth and flowering characters was also reported by Abdel Aziz et al. (2009) and Khalil (2015) on gladiolus, Kasim and Adil (2014) on Freesia hybrid, Mohammed et al. (2016) on dahlia and Farahat et al. (2017) on Monstera delicious plants.

The aim of this work was to study the effect of FYM, Minia Azotein (M.A.) and/or some vitamins (E and C) treatments on the vegetative growth and flowering of Gladiolus grandiflorus var. Gold Field plants.

MATERIALS AND METHODS

A field experiment was carried out during the two successive seasons of 2016/2017 and 2017/2018 at the Nursery and Laboratory of Ornamental Plants, Faculty of Agriculture, Minia University to figure out the response of the Gladiolus grandiflorus var. Gold Field plants to FYM, Minia Azotein (M.A.) and/or some vitamins (E and C) treatments.

The corms of gladiolus were obtained from Holland by Basiony Nurseries, Cairo, Egypt. Average corm diameter was 2.7 and 3.3 cm and corm weight were 9.4 and 10.2 g for the first and second seasons, respectively. Corms were planted on October 1st for both seasons in 1.5 × 2.0 m plots containing 3 ridges, 50 cm apart. Corms were planted in hills, 20 cm apart (10 corms/ridge). The physical and chemical analysis of the used soil in both seasons were determined according to Jackson (1973) and shown in Table (a).

The split plot design with three replicates was followed in this experiment. The four levels of farmyard manure fertilization treatments were considered as main plots and the seven treatments of Minia Azotein (M.A.) and/or some vitamins (E and C) the sub plots. The four levels of farmyard manure treatments were 0, 10, 15 and 20 m3/fed. The chemical analysis of FYM was done according to Black et al. (1965) and is shown in Table (b).

The sub plots were as follows: control, alpha tocopherols (vit. E) at 50 ppm, ascorbic acid (vit. C) at 50 ppm, Minia Azotein (M.A.) at 50 ml/plant, M.A. + vit. E, M.A. + vit. C and M.A. + vit. E + vit. C. Vitamin E and C were sprayed three times, one month and two months after planting and after flower cut.

The following data were recorded

1. Vegetative growth characters just before flowering: leaf length (cm), number of leaves/plant and dry weight of leaves/plant (g).

2. Flowering characters: length of spike (cm), spike diameter (mm), spike fresh weight (g), number of florets/spike, lower floret diameter (cm) and lower floret fresh weight (g).

Data of the two experiments were subjected to the statistical analysis of variance using MSTAT-C (1986). L.S.D. test at 5 % was used to compare the means of treatments.
RESULTS AND DISCUSSION

1. Vegetative growth characters:

Data presented in Table (1) showed that leaf length (cm), number of leaves/plant and leaves dry weight/plant (g) of gladiolus were significantly increased, in both seasons, due to the use of 10, 15 and 20 m$^3$/fed FYM in comparison with those of control plants. Moreover, the increase was gradually by the gradual increase in FYM level. The increase in vegetative growth traits due to FYM at levels of 10, 15 and 20 m$^3$/fed over the control reached 9.18, 15.57 and 23.30 % for leaf length, 4.11, 7.59 and 11.08 % for leaf number and 30.67, 48.67 and 65.67 % for leaves dry weight, respectively, in the first season and by 2.89, 12.70 and 18.94 % for leaf length, 12.24, 21.13 and 28.87 % for number of leaves and 13.29, 21.45 and 30.51 for leaves dry weight, respectively in the second one. Similar results were found by Pandey et al. (2013), Abdou and Ibrahim (2015), Abdou et al. (2018) and Pal and Singh (2019) on gladiolus, Treder (2008) and El-Naggar and El-Nasharty (2009) on Hippeastrum vittatum, Moghadam et al. (2012) on lily, Pandey et al. (2017) on dahlia, Abduallah (2019) on Iris and Samoon et al. (2019) on Alstroemeria plant. The increase of vegetative growth resulting from using FYM as organic fertilization might be due to that organic matter is considered an important factor for improving the physical, chemical and biological properties of the soil and consequently, increasing plant growth (Munne-Bosch and Algere, 2002).

Data presented in Table (1) indicated that, leaf length, number of leaves/plant and leaves dry weight of gladiolus were significantly increased, in both seasons, due to the use of Minia Azotein (M.A.) and/or some vitamins (E and C), each at 50 ppm either used separately or together in comparison with control. The combined treatments of Minia Azotein (M.A.) plus vitamin E plus vitamin C seemed to be more effective than other treatments. In conformity with these results were those detected by Taha and Hassan (2008), Mazhar and Eid (2016), Pansuriya et al. (2018)
Table 1. Effect of farmyard manure (FYM), biofertilizer and/or some vitamin treatments, as well as, their combination treatments on leaf length, number of leaves/plant (cm) and leaves dry weight (g) of *Gladiolus grandiflorus* var. Gold Field during the first and second seasons.

| Biofertilization and some vitamin treatments (B) | FYM levels (m³/fed) (A) | 1st season (2016/2017) | 2nd season (2017/2018) | Mean (B) | Mean (B) |
|-----------------------------------------------|-------------------------|------------------------|------------------------|----------|----------|
| Leaf length (cm)                              |                         | 0 10 15 20             | 0 10 15 20             |          |          |
| Control                                       | 45.62 49.54 53.16 57.21 | 51.38 44.67 44.67 48.67 | 51.00 47.25 |          |          |
| Alpha tocopherol (vit. E)                     | 48.71 52.23 56.02 60.00 | 54.24 47.00 47.00 52.33 | 53.00 49.83 |          |          |
| Ascorbic acid (vit. C)                        | 51.87 55.66 59.24 63.14 | 57.48 47.67 49.33 53.33 | 56.67 51.75 |          |          |
| Minia Azotein (M.A.)                          | 54.50 58.40 61.69 66.02 | 60.15 50.33 50.67 55.00 | 58.33 53.58 |          |          |
| M.A. + vit. E                                 | 57.79 64.50 67.74 72.02 | 65.51 52.00 55.00 59.33 | 65.00 57.83 |          |          |
| M.A. + vit. C                                 | 61.24 67.59 70.88 74.91 | 68.66 53.33 56.67 63.67 | 68.00 60.42 |          |          |
| Mean (A)                                      | 53.57 58.49 61.91 66.05 | 49.52 50.95 55.81 58.90 |          |          |          |
| L.S.D. at 5 %                                 | A: 1.18 B:1.05 AB: 2.10 | A: 1.41 B: 1.62 AB: 3.24 |          |          |          |

| Number of leaves/plant                        |                         |                        |          |          |
| Control                                       | 5.96 6.08 6.30 6.58 6.23 | 7.05 8.05 8.57 9.57 8.31 |          |          |          |
| Alpha tocopherol (vit. E)                     | 6.04 6.21 6.57 6.73 6.39 | 7.55 8.55 9.55 10.08 8.93 |          |          |          |
| Ascorbic acid (vit. C)                        | 6.10 6.46 6.72 6.83 6.53 | 8.10 9.15 10.06 10.72 9.51 |          |          |          |
| Minia Azotein (M.A.)                          | 6.37 6.71 6.82 6.93 6.71 | 9.05 10.05 10.57 11.11 10.20 |          |          |          |
| M.A. + vit. E                                 | 6.42 6.79 6.88 7.21 6.83 | 9.13 10.22 11.06 11.73 10.54 |          |          |          |
| M.A. + vit. C                                 | 6.62 6.87 7.04 7.37 6.98 | 9.59 10.84 11.55 12.22 11.05 |          |          |          |
| M.A. + vit. E + vit. C                        | 6.75 6.96 7.29 7.46 7.12 | 10.16 11.21 12.05 12.72 11.54 |          |          |          |
| Mean (A)                                      | 6.32 6.58 6.80 7.02 | 8.66 9.72 10.49 11.16 |          |          |          |
| L.S.D. at 5 %                                 | A: 0.19 B: 0.04 AB: 0.08 | A: 0.26 B: 0.09 AB: 0.18 |          |          |          |

| Leaves dry weight (g)                         |                         |                        |          |          |
| Control                                       | 1.16 2.70 3.01 3.69 2.64 | 2.65 2.97 3.35 3.72 3.17 |          |          |          |
| Alpha tocopherol (vit. E)                     | 2.29 2.93 3.67 4.13 3.26 | 2.78 3.29 3.62 3.88 3.39 |          |          |          |
| Ascorbic acid (vit. C)                        | 2.81 3.63 4.05 4.66 3.79 | 3.19 3.56 3.84 4.10 3.67 |          |          |          |
| Minia Azotein (M.A.)                          | 3.12 3.96 4.55 4.90 4.13 | 3.36 3.82 3.99 4.35 3.88 |          |          |          |
| M.A. + vit. E                                 | 3.45 4.35 4.84 5.35 4.50 | 3.49 3.96 4.25 4.54 4.06 |          |          |          |
| M.A. + vit. C                                 | 3.90 4.70 5.30 5.87 4.94 | 3.76 4.22 4.50 4.70 4.30 |          |          |          |
| M.A. + vit. E + vit. C                        | 4.27 5.18 5.81 6.18 5.36 | 3.93 4.46 4.61 4.96 4.49 |          |          |          |
| Mean (A)                                      | 3.00 3.92 4.46 4.97 | 3.31 3.75 4.02 4.32 |          |          |          |
| L.S.D. at 5 %                                 | A: 0.46 B: 0.34 AB: 0.68 | A: 0.26 B: 0.18 AB: 0.36 |          |          |          |
and Bohra and Nautiyal (2019) on gladiolus, El-Naggar and Mahmoud (1994) on narcissus, Abdou (2004) on dahlia and Attia et al. (2018) on tuberose plant regarding the effect of biofertilizer. Moreover, Abdou et al. (2012) on mint, Ibrahim (2014) on khella and Mohamed (2016) on Antirrhinum majus plant concerning the influence of vitamin E. Also, Abdel Aziz et al. (2009), Abo Leila and Eid (2011) and Khalil (2015) on gladiolus, Kasim and Adil (2014) on Freesia, Mohammed et al. (2016) on dahlia and Gaber (2019) on Pelargonium zonale plant concerning the effect of vitamin C attained similar results.

Application of active biofertilizer (Minia Azotein "M.A.") as a commercial biofertilizers stimulate containing N-fixing bacteria on gladiolus plants. Many investigators explained the role of N-fixing bacteria (Jagnow et al., 1991; Hauwaka, 2000 and Gadagi et al., 2004).

The most important function of α-tocopherol is to act as recyclable chain reaction terminators of polyunsaturated fatty acids, free radicals generated by lipids oxidation (Munne-Bosch and Algere, 2002).

Ascorbic acid is the most abundant antioxidant which protects plant cells, or antioxidant defense, photoprotection and regulation of photosynthesis and growth (Dewick, 2000).

The interaction between FYM, Minia Azotein and/or some vitamin treatments was significant in the two seasons for all previous characters. The maximum values were obtained due to fertilizing the soil of gladiolus with high level of FYM (20 m³/fed) and adding Minia Azotein biofertilizer at the rate of 50 ml/hill and spraying plants with vitamin E (50 ppm) + vitamin C (50 ppm).

2. Flowering parameters:

Data presented in Tables (2 and 3) indicated that all FYM levels caused significant increases in length of spike (cm), spike diameter (mm), spike fresh weight (g), number of florets/spike, lower floret diameter (cm) and lower floret fresh weight (g), in the two seasons, in comparison with those of untreated plants. The means of flowering parameters were gradually increased according to the increase in levels of farmyard manure fertilizer. The application of FYM at high level (20 m³/fed) resulted the highest values of various flowering traits. These results are in close with those obtained by Atta-Alla et al. (2003), Khalil (2015) and Baruati et al. (2018) on gladiolus, Abass (2003), Abdel-Sattar et al. (2010), Srivastava et al. (2014) and Karim et al. (2017) on tuberose, El-Naggar and El-Nasharty (2009) on Hippeastrum vittatum.

A possible explanation to the positive effect of FYM fertilizer treatments might be attributed to its stimulative effects on different vegetative growth (Tables, 2 and 3). Better vegetative growth should be directly reflected on various flowering aspects.

Regarding the effect of Minia Azotein biofertilizer and/or vitamin (E and C) treatments, data presented in Tables (2 and 3) revealed that all six treatments significantly increased length of spike (cm), spike diameter (mm), spike fresh weight (g), number of florets/spike, lower floret diameter (cm) and lower floret fresh weight (g) compared with untreated plants. The highest values for all flowering characters were obtained due to gladiolus plants inoculated with Minia Azotein (M.A.) biofertilizer plus spraying with alpha tocopherol and ascorbic acid each at 50 ppm in both seasons.

This finding was similar to those obtained by Pansuriya et al. (2018) on gladiolus regarding the influence of Minia Azotein biofertilizer treatment. Moreover, Khalil (2015) on gladiolus regarding the effects of vitamin E. Also, Abdel Aziz et al. (2009) and Khalil (2015) on gladiolus plant regarding the influence of vitamin C.

The interaction treatments exhibited a significant effect on all flowering parameter. The highest values were obtained with FYM
Table 2. Effect of farmyard manure (FYM), biofertilizer and/or some vitamin treatments, as well as, their combination treatments on length of spike (cm), spike diameter (mm) and spike fresh weight (g) of *Gladiolus grandiflorus* var. Gold Field during the first and second seasons.

| Biofertilization and some vitamin treatments (B) | FYM levels (m³/fed) (A) |  |  |  |  | Mean (B) |  |  |  | Mean (B) |
|------------------------------------------------|-------------------------|---|---|---|---|--------|---|---|---|--------|
|                                                | 1st season (2016/2017)  | 0 | 10 | 15 | 20 | Mean (B) | 0 | 10 | 15 | 20 | Mean (B) |
| Length of spike (cm)                           |                         |   |    |    |    |         |   |    |    |      |         |
| Control                                        | 45.79                   | 53.58 | 54.08 | 55.22 | 52.17 | 60.32 | 63.17 | 65.31 | 67.82 | 64.16 |
| Alpha tocopherol (vit. E)                      | 53.04                   | 53.96 | 54.71 | 56.23 | 54.49 | 61.01 | 63.32 | 67.55 | 69.50 | 65.35 |
| Ascorbic acid (vit. C)                         | 53.66                   | 54.53 | 56.04 | 57.33 | 55.39 | 63.29 | 67.47 | 69.39 | 72.04 | 68.05 |
| Minia Azotein (M.A.)                           | 54.17                   | 55.87 | 57.26 | 59.12 | 56.81 | 65.57 | 68.98 | 71.14 | 73.00 | 69.67 |
| M.A. + vit. E                                  | 54.31                   | 57.20 | 58.79 | 60.96 | 57.82 | 67.44 | 70.21 | 72.17 | 74.07 | 70.97 |
| M.A. + vit. C                                  | 55.25                   | 58.29 | 59.95 | 61.79 | 58.82 | 68.63 | 72.10 | 73.81 | 75.80 | 72.59 |
| M.A. + vit. E + vit. C                         | 56.49                   | 59.37 | 61.33 | 61.81 | 59.75 | 69.85 | 73.35 | 75.16 | 76.10 | 73.62 |
| Mean (A)                                       | 53.24                   | 56.11 | 57.45 | 58.92 |          | 65.16 | 68.37 | 70.65 | 72.62 |          |
| L.S.D. at 5 %                                  | A: 1.13                 | B: 0.55 | AB: 1.10 | | | | | | | |
| Spike diameter (mm)                            |                         |   |    |    |    |         |   |    |    |      |         |
| Control                                        | 0.51                    | 0.53 | 0.59 | 0.65 | 0.57 | 0.40 | 0.43 | 0.48 | 0.53 | 0.46 |
| Alpha tocopherol (vit. E)                      | 0.52                    | 0.58 | 0.64 | 0.69 | 0.61 | 0.42 | 0.45 | 0.52 | 0.57 | 0.49 |
| Ascorbic acid (vit. C)                         | 0.57                    | 0.62 | 0.68 | 0.73 | 0.65 | 0.44 | 0.51 | 0.56 | 0.62 | 0.53 |
| Minia Azotein (M.A.)                           | 0.60                    | 0.67 | 0.72 | 0.76 | 0.69 | 0.49 | 0.55 | 0.61 | 0.67 | 0.58 |
| M.A. + vit. E                                  | 0.61                    | 0.71 | 0.75 | 0.81 | 0.72 | 0.50 | 0.60 | 0.66 | 0.79 | 0.64 |
| M.A. + vit. C                                  | 0.66                    | 0.74 | 0.78 | 0.84 | 0.76 | 0.54 | 0.65 | 0.73 | 0.83 | 0.69 |
| M.A. + vit. E + vit. C                         | 0.70                    | 0.77 | 0.83 | 0.86 | 0.79 | 0.58 | 0.68 | 0.81 | 0.86 | 0.73 |
| Mean (A)                                       | 0.60                    | 0.66 | 0.71 | 0.76 |          | 0.48 | 0.55 | 0.62 | 0.70 |          |
| L.S.D. at 5 %                                  | A: 0.03                 | B: 0.02 | AB: 0.04 | | | | | | | |
| Spike fresh weight (g)                         |                         |   |    |    |    |         |   |    |    |      |         |
| Control                                        | 7.47                    | 7.77 | 8.26 | 10.03 | 8.38 | 11.82 | 14.02 | 16.54 | 18.01 | 15.10 |
| Alpha tocopherol (vit. E)                      | 7.71                    | 8.18 | 9.74 | 10.89 | 9.13 | 13.05 | 16.13 | 17.82 | 19.09 | 16.52 |
| Ascorbic acid (vit. C)                         | 7.87                    | 9.15 | 10.60 | 11.62 | 9.81 | 15.28 | 17.31 | 18.89 | 20.37 | 17.96 |
| Minia Azotein (M.A.)                           | 8.81                    | 10.42 | 11.54 | 12.56 | 10.83 | 17.17 | 18.31 | 20.24 | 21.14 | 19.22 |
| M.A. + vit. E                                  | 9.08                    | 11.40 | 12.39 | 13.63 | 11.63 | 17.19 | 19.72 | 21.04 | 22.00 | 19.99 |
| M.A. + vit. C                                  | 10.37                   | 12.38 | 13.37 | 14.57 | 12.67 | 18.03 | 20.84 | 21.54 | 23.35 | 20.94 |
| M.A. + vit. E + vit. C                         | 11.31                   | 12.80 | 14.37 | 14.63 | 13.28 | 19.45 | 21.20 | 22.84 | 23.55 | 21.76 |
| Mean (A)                                       | 8.95                    | 10.30 | 11.47 | 12.56 |          | 16.00 | 18.22 | 19.84 | 21.07 |          |
| L.S.D. at 5 %                                  | A: 1.08                 | B: 0.40 | AB: 0.80 | | | | | | | |

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Table 3. Effect of farmyard manure (FYM), biofertilizer and/or some vitamin treatments, as well as, their combination treatments on number of florets/spike, lower floret diameter and lower floret fresh weight (g) of *Gladiolus grandiflorus* var. Gold Field during the first and second seasons.

| Biofertilization and some vitamin treatments (B) | FYM levels (m³/fed) (A) | 1st season (2016/2017) | 2nd season (2017/2018) | Mean (B) | Mean (B) |
|------------------------------------------------|-------------------------|------------------------|------------------------|----------|----------|
|                                                  | 0  10  15  20          |                        |                        |          |          |
| Number of florets/spike                          |                                        |                        |                        |          |          |
| Control                                         | 6.72 7.15 7.43 7.75       | 7.26 7.51 7.83 8.36    | 8.67 8.09             |          |          |
| Alpha tocopherol (vit. E)                       | 7.12 7.41 7.73 8.29      | 7.64 7.62 8.31 8.66    | 8.94 8.38             |          |          |
| Ascorbic acid (vit. C)                          | 7.40 7.71 8.16 8.54      | 7.95 8.00 8.54 8.93    | 9.32 8.70             |          |          |
| Minia Azotein (M.A.)                            | 7.46 8.08 8.50 8.89      | 8.23 8.40 8.87 9.28    | 9.55 9.03             |          |          |
| M.A. + vit. E                                  | 7.57 8.46 8.68 9.21      | 8.48 8.46 9.06 9.51    | 9.93 9.24             |          |          |
| M.A. + vit. C                                  | 7.87 8.66 8.97 9.50      | 8.75 8.78 9.49 9.79    | 10.08 9.54            |          |          |
| M.A. + vit. E + vit. C                         | 8.45 8.95 9.44 9.91      | 9.19 9.00 9.57 9.98    | 10.33 9.72            |          |          |
| Mean (A)                                       | 7.51 8.06 8.42 8.87      | 8.25 8.81 9.22 9.55    |                       |          |          |
| L.S.D. at 5 %                                   | A: 0.43  B:0.24 AB:0.48  | A: 0.31  B: 0.18 AB: 0.36 |          |          |
| Lower floret diameter (cm)                      |                                        |                        |                        |          |          |
| Control                                         | 6.48 7.04 7.32 7.71       | 7.14 6.50 7.14 7.30    | 7.84 7.20             |          |          |
| Alpha tocopherol (vit. E)                       | 6.94 7.16 7.68 7.88      | 7.42 6.88 7.29 7.78    | 8.13 7.52             |          |          |
| Ascorbic acid (vit. C)                          | 7.09 7.55 7.86 8.15      | 7.66 7.16 7.65 7.93    | 8.19 7.73             |          |          |
| Minia Azotein (M.A.)                            | 7.37 7.84 8.10 8.28      | 7.90 7.46 7.92 8.17    | 8.51 8.02             |          |          |
| M.A. + vit. E                                  | 7.47 8.09 8.22 8.47      | 8.06 7.55 8.16 8.47    | 8.73 8.23             |          |          |
| M.A. + vit. C                                  | 7.74 8.16 8.33 8.53      | 8.19 7.85 8.39 8.71    | 8.77 8.43             |          |          |
| M.A. + vit. E + vit. C                         | 7.93 8.30 8.51 8.71      | 8.36 8.15 8.67 8.75    | 8.98 8.64             |          |          |
| Mean (A)                                       | 7.29 7.73 8.00 8.25      | 7.36 7.39 8.16 8.45    |                       |          |          |
| L.S.D. at 5 %                                   | A: 0.20  B:0.09 AB:0.18  | A: 0.23  B: 0.11 AB: 0.22 |          |          |
| Lower floret fresh weight (g)                   |                                        |                        |                        |          |          |
| Control                                         | 3.16 3.45 3.51 3.84       | 3.49 3.22 3.51 3.58    | 3.83 3.54             |          |          |
| Alpha tocopherol (vit. E)                       | 3.40 3.48 3.81 3.99      | 3.67 3.33 3.56 3.81    | 4.04 3.69             |          |          |
| Ascorbic acid (vit. C)                          | 3.46 3.76 3.87 4.10      | 3.80 3.52 3.77 3.98    | 4.28 3.89             |          |          |
| Minia Azotein (M.A.)                            | 3.60 3.86 4.05 4.22      | 3.93 3.69 3.95 4.27    | 4.47 4.10             |          |          |
| M.A. + vit. E                                  | 3.74 4.02 4.19 4.72      | 4.17 3.71 4.25 4.46    | 4.73 4.29             |          |          |
| M.A. + vit. C                                  | 3.85 4.12 4.30 4.83      | 4.28 3.91 4.41 4.56    | 5.04 4.48             |          |          |
| M.A. + vit. E + vit. C                         | 4.01 4.26 4.76 5.17      | 4.55 4.09 4.48 4.77    | 5.19 4.63             |          |          |
| Mean (A)                                       | 3.60 3.85 4.07 4.41      | 3.64 3.99 4.20 4.51    |                       |          |          |
| L.S.D. at 5 %                                   | A: 0.21  B:0.17 AB:0.34  | A: 0.18  B: 0.15 AB: 0.30 |          |          |
at 20 m³/fed in combination with Minia Azotein biofertilizer plus vitamin E + vitamin C.

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معاملة إضافة سماد المزرعة بمعدل 0.2 م/فدان مع سماد المنية أزوتين + فيتامين ج تليها استعمال سماد المزرعة بمعدل 0.5 م/فدان مع خليط من السماد الحيوي (المنية أزوتين) + فيتامين ه + فيتامين ج وبذلك يمكن التوصية بهذه المعاملات للحصول على أفضل نمو خضري وأفضل انتاج للأزهار من حيث الكم والجودة.