IMPACTS OF COMPOST, BIOFERTILIZER AND/OR SOME ANTIOXIDANT TREATMENTS ON GLADIOLUS (GLADIOLUS GRANDIFLORAS)

A. VEGETATIVE GROWTH AND FLOWERING ASPECTS

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ABSTRACT: A field experiment was carried out during two successive seasons of 2018/2019 and 2019/2020 at the Nursery of Ornamental plants, Faculty of Agriculture, Mania University. The aim of this study was to investigate impacts of compost at four levels (0, 5, 10 and 15 ton/fed) in combination with Microbein biofertilizer (M.B.) at 50 ml/plant and/or some antioxidant treatments (salicylic and ascorbic acids) on vegetative growth and flowering of Gladiolus grandiflorus var. Jester plants. Results showed that vegetative growth and flowering parameters of 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 with significant differences by increasing levels of compost. In addition, Microbein biofertilizer (M.B.) and/or some antioxidant (salicylic and ascorbic acids) treatments significantly increased all vegetative growth and flowering parameters in comparison with control treatment. Microbein biofertilizer plus salicylic acid and ascorbic acid were more effective in this concern. It was found also that the use of compost (15 ton/fed) in combination with Microbein biofertilizer plus salicylic acid plus ascorbic acid followed by 15 ton/fed with M.B. plus ascorbic acid then 10 ton/fed with M.B. plus salicylic acid plus ascorbic acid noticeably improved different vegetative growth characters and flowering parameters of gladiolus plants. As the most important characters for the quality of gladiolus, the largest length of spike (season one 65.76 cm and season two 65.76 cm), largest number of florets/spike (season one 11.65 and season two 11.98) and the highest lower floret diameter (season one 7.79 cm and season two 8.34 cm) were achieved with compost (15 ton/fed) in combination with Microbein biofertilizer plus salicylic acid plus ascorbic acid. From the results of this study, it could be concluded that adaptability of gladiolus corms of Jester variety (Gladiolus grandiflorus) to the Egyptian environmental conditions is confirmed.

Key words: Microbein biofertilizer, gladiolus, flowering, antioxidant.

INTRODUCTION

Gladiolus (sword lily) is known as queen of bulbous flowers due to their elegant attractive spikes of different hues, varying sizes and long vase life (Jabbar et al., 2018). Gladiolus (Gladiolus grandiflorus, L.) is an important cut flower belongs to Iridaceae family. Gladiolus occupies fourth place in the international trade after rose, carnation...
and chrysanthemum, in the cut flower industry (Tirkey et al., 2017). Gladiolus is derived from the native plants of south and central Africa, as well as, the Mediterranean region (De-Hertogh and Le Nard, 1995). The importance of gladiolus as cut flowers is increasing day by day in domestic, as well as, international market. It is also ideal both for garden display and floral arrangements for table and interior decoration as well as making high quality bouquet (Lepcha et al., 2007).

Organic, Microbein biofertilizer (M.B.) and some antioxidants (salicylic and ascorbic acids) 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 Chandar et al. (2012), Pandey et al. (2013), Abdou and Ibrahim (2015), Abdou et al. (2018), Baruati et al. (2018) and Beck et al. (2019) on gladiolus plants, Kabir et al. (2011), Srivastava et al. (2014), Pattnaik (2016) and Preetham et al. (2017) on tuberose plant, Kiran et al. (2013) and Pandey et al. (2017) on dahlia and Rajaei and Onsinejad (2014) on tulip plant. The role of Microbein biofertilizer (M.B.) in improving vegetative growth and flowering parameters was revealed by Dalve et al. (2009), Kaushik et al. (2016), Zehra et al. (2017), Sathyanarayana et al. (2018) and Bohra and Nautiyal (2019) on gladiolus, Kumar et al. (2012), Attia et al. (2018) and Avinash et al. (2019) on tuberose, Fayaz et al. (2018) on tulip plant. The role of ascorbic acid (vit. C) in improving vegetative growth and flowering characters was also mentioned by Abdel Aziz et al. (2009), Abo Leila and Eid (2011) and Khalil (2015) on gladiolus, Kasim and Adil (2014) on Freesia hybrid, Mohammed et al. (2016) on dahlia plant and Gaber (2019) on Pelargonium zonale plant.

One of the most important quality factors of each cut flower is the post-harvest life. Application of benzyladenine (BA) and salicylic acid (SA) reduces ethylene production and thus increases the longevity of cut flowers. SA also reduces the effects of biotic and abiotic stresses such as heat, salinity, and drought (Abbasi et al., 2020). The plant growth regulators (PGRs) increase the antioxidant capacity of cells, and this mechanism could possibly reduce the aging process in the harvested crops and cut flowers. Therefore, the application of SA in cut flowers can influence the antioxidant system and increase the vase life (Ezhilmathi et al., 2007). The use of 5-sulfosalicylic acid in gladiolus cut flowers increases water absorption, vase life, and number of open florets and also reduces the number of unopened florets compared with control samples (Ezhilmathi et al., 2007). Furthermore, it has been reported that the application of SA increased the vase life and body weight and diameter of flower in Samurai cultivar of rose flowers, but adversely affected the percentage of flower opening (Abbasi et al., 2020).

The role of salicylic acid in increasing vegetative growth and flowering parameters was reported by Pal et al. (2015), Tamrakar et al. (2018) and Al-Hasnawi et al. (2019) on gladiolus, Ahmad et al. (2018) and Nassour et al. (2019) on tuberose, Kumari et al. (2018) on lily, Ramzan et al. (2018) on iris, Aashutosh et al. (2019) on chrysanthemum plant.

Jester variety (yellow flowers) of gladiolus corms (Gladiolus gradiflorus) is a well-known variety for its adaptability to the Egyptian environmental conditions as well increased high potentials of its flowers exporting. Therefore, the aim of this work was to study the effects of compost, Microbein biofertilizer (M.B.) and/or some antioxidant (salicylic and ascorbic acids) treatments on the vegetative growth and flowering of gladiolus (Gladiolus grandiflorus, L.) var. Jester plants.

**MATERIALS AND METHODS**

A field experiment was carried out during two successive seasons of 2018/2019...
and 2019/2020 at the Nursery and Laboratory of Ornamental plants, Faculty of Agriculture, Minia University to figure out the response of Gladiolus graniflorus var. Jester plants to compost, Microbein biofertilizer (M.B.) and/or some antioxidant (salicylic and ascorbic acids) treatments. The corms of gladiolus were imported from Holland by Basiony Nurseries, Cairo, Egypt. Average corm diameter was 2.6 and 3.2 cm and corm weight were 9.5 and 10.4 g for the first and second seasons, respectively, all corms were soaking for one minute in Pinilate (fungicide) at the concentration of 1 g/l before planting in both successive experimental seasons. For both seasons, on 1st of October soil plots (1.5 × 2.0m) were prepared then corms were implanted in hills, 20 cm apart, each plot contains 3 ridges, 50 cm apart (10 corms/ridge). The physicochemical properties of the investigated soil in this study were determined according to Jackson (1973) and Page et al. (1982) and shown in Table (1).

The experimental design was split plot with three replicates. Four levels of compost fertilization were considered as main plots and the seven treatments of Microbein biofertilizer (M.B.) and/or some antioxidant (salicylic acid and vitamin C) treatments as the sub plots. The four levels of compost were 0, 5, 10 and 15 ton/fed. The sub plots were as follows: (control, salicylic acid (S.A.) at 50 ppm, ascorbic acid (vit. C) at 50 ppm, Microbein biofertilizer (M.B.) at 50 ml/plant, M.B. + S.A., M.B. + vit. C and M.B. + S.A. + vit. C). Salicylic and ascorbic acids were obtained from Shoura Company and were sprayed three times, one month and two months after planting and after flowers cut. The plants were sprayed till run off. The Microbein was obtained from laboratory of Biofertilizers, Department of Genetics, Fac. of Agric., Minia Univ., and were applied to the soil three times (one month and two months after planting and after flowers cut) around the plant roots at the rate of 50 ml/plant.

The compost (plant residues) was obtained from Egyptian Company for recycling solid Residues, at New El-Minia City (Organic Nile Compost). Compost was added during preparing the soil for cultivation in both experimental seasons. Nutrient composition and physicochemical properties of the investigated compost (Organic Nile Compost) are shown in Table (2).

The following data were recorded:
1. Vegetative growth traits were recorded just before flowering such as leaf length (cm), number of leaves/plant and dry weight of leaves/plant (g).
2. Flowering characters recorded were length of spike (cm), spike diameter (mm), spike fresh weight (g), number of florets/spikes, lower floret diameter (cm) and lower floret fresh weight (g).

Statistical analysis:
Data of the experiments were subjected to the statistical analysis of variance using MSTAT-C (1986).

Table 1. Some soil physiochemical properties of the investigated soil.

| Character | Soil chemical properties | Soil physical properties |
|-----------|--------------------------|--------------------------|
| pH (1:2.5 water) | Value | Character | Value | Character | Value |
| 7.7 | Total P (g kg⁻¹) | 0.56 | F.C. % | 42.45 |
| 17.9 | Available P (mg kg⁻¹) | 13.11 | PWP % | 13.78 |
| 37.87 | Total K (g kg⁻¹) | 4.37 | WHC % | 48.76 |
| 1.35 | Exch. K⁺ (mg/100 g soil) | 2.85 | A.V. (F.C. – PWP) % | 28.67 |
| 28.61 | Exch. Ca⁺⁺ (mg/100 g soil) | 31.12 | A.V. (WHC-PWP) % | 34.98 |
| 129 | Exch. Mg⁺⁺ (mg/100 g soil) | 8.77 | Bulk density (BD) g/cm³ | 1.31 |
| 22.17 | Exch. Na⁺⁺ (mg/100 g soil) | 2.52 | Particle density (PD) g/cm³ | 2.22 |
| 18.48 | DTPA Ext. (mg kg⁻¹) Fe | 8.23 | Sand % | 28.9 |
| 0.76 | Cu | 2.01 | Silt % | 32.8 |
| 24.31 | Zn | 2.87 | Clay % | 38.3 |
| 58.46 | Mn | 8.11 | Soil texture | Clay loam |
Table 2. Nutrient composition and physicochemical properties for the investigated compost.

| Compost property               | Value        | Compost property   | Value       |
|-------------------------------|--------------|--------------------|-------------|
| Dry weight of 1 m³            | 450 kg       | C/N ratio          | 26.50       |
| Fresh weight of 1 m³          | 650-700 kg   | N/P ratio          | 2.00        |
| Moisture weight (%)           | 36.60 %      | Total P (g kg⁻¹) (D.M.) | 5.0         |
| pH (1:2.5)                    | 7.90         | Total K (g kg⁻¹) (D.M.) | 9.0         |
| EC (ds m⁻³ at 25 C⁰)          | 2.20         | Total Ca (g kg⁻¹) (D.M.) | 26.3       |
| CEC (emol. kg⁻²)              | 45.66        | Total Mg (g kg⁻¹) (D.M.) | 6.6         |
| Dry solids %                  | 63.40        | NaCl (%)           | 0.72-0.75   |
| Ash%                          | 9.90         | Fe (mg kg⁻¹)       | 150-200     |
| Total N (g kg⁻¹) (D.M.)       | 10.0         | Mn (mg kg⁻¹)       | 25-56       |
| Total Organic Matter (%)      | 32-34 %      | Cu (mg kg⁻¹)       | 75-150      |
| Total Organic carbon (%)      | 18.5-19.7 %  | Zn (mg kg⁻¹)       | 150-225     |

Least significant difference (L.S.D) test at the probability level of 5% was used to compare the average means of treatments.

RESULTS AND DISCUSSION

Vegetative growth characters:

Data in Table (3) show 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 compost at 5, 10 and 15 ton/fed in comparison with those of untreated plants. The highest values were obtained from compost at the highest level of 15 ton/fed. The increase of vegetative growth resulting from using compost as organic fertilization treatment might be due to the fact that organic matter is considered as an important factor for improving physical, chemical and biological properties of the soil and consequently, increased plant growth parameters (Saber, 1997; Judais and Rinaldi, 2001 and Taiwo et al., 2002). Similar results were obtained by Ahmed (2013), Khalil (2015), Dewantier Da Cruz et al. (2018) and Kumar and Saravanan (2019) on gladiolus, El-Sayed et al. (2012) on freesia, Mirkalae et al. (2013) and Prasad et al. (2017) on lily, Srivastava et al. (2014) and Pattnaik (2016) and Karim et al. (2017) on tuberose, Abduallah (2019) on iris plant.

Data in Table (3) indicated that, leaf length (cm), number of leaves/plant and leaves dry weight (g) were significantly increased, in both seasons, due to the use of seven treatments of Microbein biofertilizer (M.B.) and/or some antioxidant (salicylic acid and vitamin C) treatments in comparison with untreated control. The combined treatment of Microbein biofertilizer (M.B.) plus salicylic acid plus vitamin C seemed to be more effective than either biofertilizer alone or antioxidants. In conformity with these results were those detected by Kashyap (2016), Zehra et al. (2017), Pansuriya et al. (2018) and Bohra and Nautiyal (2019) on gladiolus, Kumar et al. (2012), Attia et al. (2018) and Avinash et al. (2019) on tuberose and Pandey et al. (2017) on dahlia plant.

The role of Microbein as biofertilizer in promoting vegetative growth might be attributed to the increase in nutrients uptake and plant contents or synthesis of plant hormone. Consequently, increasing the formation of metabolites which encourage the vegetative growth and enhance meristematic activity of cells and tissues to improve leaf production (Dadarwall et al., 1997; Hedge et al., 1999; Hauwaka, 2000 and Gadagi et al., 2004).

In plants, antioxidants were believed to protect chloroplast membranes from photooxidation and help to provide an optimal environment for the photosynthetic machinery (Munne-Bosch and Algere, 2002). The role of salicylic acid treatments in increasing vegetative growth was
The interaction between both experimental factors (A×B) was significant in both seasons for leaf length, leaf number and leaves dry weight. The maximum values of leaf length (cm), number of leaves/plant and leaves dry weight/plant (g), were obtained due to supplying the soil of gladiolus with 15 ton/fed compost in combination with Microbein biofertilizer (M.B.) plus salicylic acid plus vitamin C followed by high level of compost (15 ton/fed) with Microbein biofertilizer (M.B.)

| Treatments (B)                | Compost levels (ton/fed) (A) | Leaf length (cm) | Number of leaves/plant | Leaves dry weight (g) |
|-------------------------------|------------------------------|------------------|------------------------|-----------------------|
|                               | 1st season (2018/2019)       | 2nd season (2019/2020) |
|                               | Mean (B)                     | Mean (B)         | Mean (B)               | Mean (B)              |
|                               | 0   | 5   | 10  | 15  | 0   | 5   | 10  | 15  | 0   | 5   | 10  | 15  |
| Control                       | 46.11 | 47.49 | 48.92 | 50.39 | 48.23 | 47.03 | 48.44 | 49.90 | 51.40 | 49.19 |
| Salicylic acid (S.A.)         | 47.95 | 49.39 | 50.87 | 52.40 | 50.15 | 48.91 | 50.38 | 51.89 | 53.45 | 51.16 |
| Ascorbic acid (vit. C)        | 51.10 | 52.55 | 54.13 | 55.75 | 53.38 | 52.12 | 53.60 | 55.21 | 56.87 | 54.45 |
| Microbein biofertilizer       | 54.28 | 55.91 | 57.59 | 59.32 | 56.78 | 55.37 | 57.03 | 58.74 | 60.51 | 57.91 |
| Microbein + S.A.              | 57.75 | 59.48 | 61.27 | 63.11 | 60.40 | 58.91 | 60.67 | 62.50 | 64.37 | 61.61 |
| Microbein + vit. C            | 61.44 | 63.29 | 65.18 | 67.14 | 64.26 | 62.67 | 64.56 | 66.48 | 68.48 | 65.55 |
| Microbein + S.A. + vit. C     | 65.38 | 67.34 | 69.36 | 71.44 | 68.38 | 66.69 | 68.69 | 70.75 | 72.87 | 69.75 |
| Mean (A)                      | 54.86 | 56.49 | 58.19 | 59.94 | 55.96 | 57.62 | 59.35 | 61.13 |        |       |

L.S.D. at 5 %                  | A:1.60 | B:1.90 | AB:3.80 | A:1.66 | B:1.95 | AB:3.90 | A:0.09 | B:0.06 | AB:0.12 | A:0.11 | B:0.07 | AB:0.14 |

mentioned by Pal et al. (2015), Pawar et al. (2018) and Al-Hasnawi et al. (2019) on gladiolus, Ramtin et al. (2016) on carnation, Mohamed (2017) on aster, Ahmad et al. (2018) and Nassour et al. (2019) on tuberose plant. The role of ascorbic acid (vit. C) in improving vegetative growth was also investigated by Kasim and Adil (2014) on Freesia hybrid, Mehdikah et al. (2016) on gerbera, Mohammed et al. (2016) on dahlia plant and Gaber (2019) on Pelargonium zonale plant.
plus vitamin C then 10 ton/fed compost with the mixture of Microbein biofertilizer (M.B.) plus salicylic acid plus vitamin C treatments.

**Improvements in Flowering parameters:**

Data presented in Tables (4 and 5) show that all compost level treatments 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 both seasons, in comparison with that of untreated plants. The flowering parameters were gradually increased according to the increase in the levels of compost fertilizer in both seasons. These results are in close agreement with those obtained by Gajbhiye et al. (2013), Abdou and Ibrahim (2015), Kumar et al. (2018) and Beck et al. (2019) on gladiolus, Hatamzadeh and Masouleh (2011) on *Cymbidiums*, Shahina et al. (2012) on *Dianthus caryophyllus*, Zarghami and Mahmud (2013)

### Table 4. Effect of experimental treatments on length of spike (cm), spike diameter (mm) and spike fresh weight (g) of *Gladiolus grandiflorus* var. Jester during the first and second seasons.

| Treatments (B)                      | Length of spike (cm) | Spike diameter (mm) | Spike fresh weight (g) |
|-------------------------------------|----------------------|---------------------|------------------------|
|                                     | 1st season (2018/2019) | 2nd season (2019/2020) |                         |
|                                     | Mean (B)              | Mean (B)            |                        |
| Control                             |                       |                     |                        |
| Salicylic acid (S.A.)               |                       |                     |                        |
| Ascorbic acid (vit. C)              |                       |                     |                        |
| Microbein biofertilizer             |                       |                     |                        |
| Microbein + S.A.                    |                       |                     |                        |
| Microbein + vit. C                  |                       |                     |                        |
| Microbein + S.A. + vit. C           |                       |                     |                        |
| Mean (A)                            |                       |                     |                        |
| L.S.D. at 5%                        | A:0.22                | AB:0.04             | AB:0.08                |

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Table 5. Effect of experimental treatments on number of florets/spike, lower floret diameter (cm) and lower floret weight (g) of *Gladiolus grandiflorus* var. Jester during the first and second seasons.

| Treatments (B)     | Compost levels (ton/fd) (A) | 1st season (2018/2019) | 2nd season (2019/2020) | Mean (B) |
|--------------------|-----------------------------|------------------------|------------------------|----------|
|                    | 0                           | 5                      | 10                     | 15       |
| Control            |                             |                        |                        |          |
| Salicylic acid (S.A.) |                             |                        |                        |          |
| Ascorbic acid (vit. C) |                             |                        |                        |          |
| Microbein biofertilizer |                             |                        |                        |          |
| Microbein + S.A.   |                             |                        |                        |          |
| Microbein + vit. C |                             |                        |                        |          |
| Microbein + S.A. + vit. C |                             |                        |                        |          |
| Mean (A)           |                             |                        |                        |          |
| L.S.D. at 5 %      | A:0.15                      | B:0.16                 | AB:0.32                | A:0.19   |
|        | B:0.18                      | AB:0.36                |                        |          |

Number of florets/spike

| Treatments (B)     | 1st season (2018/2019) | 2nd season (2019/2020) | Mean (B) |
|--------------------|------------------------|------------------------|----------|
| Control            | 8.10                   | 8.34                   | 8.59     |
| Salicylic acid (S.A.) | 8.55                   | 8.81                   | 9.07     |
| Ascorbic acid (vit. C) | 8.89                   | 9.15                   | 9.43     |
| Microbein biofertilizer | 9.35                   | 9.63                   | 9.92     |
| Microbein + S.A.   | 9.69                   | 9.98                   | 10.28    |
| Microbein + vit. C | 10.11                  | 10.41                  | 10.73    |
| Microbein + S.A. + vit. C | 10.56                  | 10.88                  | 11.20    |
| Mean (A)           | 9.32                   | 9.60                   | 9.89     |
| L.S.D. at 5 %      | A:0.15                 | B:0.16                 | AB:0.32  |
|        | A:0.19                 | B:0.18                 | AB:0.36  |

Lower floret diameter (cm)

| Treatments (B)   | 1st season (2018/2019) | 2nd season (2019/2020) | Mean (B) |
|------------------|------------------------|------------------------|----------|
| Control          | 6.15                   | 6.32                   | 6.48     |
| Salicylic acid (S.A.) | 6.34                   | 6.46                   | 6.60     |
| Ascorbic acid (vit. C) | 6.51                   | 6.64                   | 6.77     |
| Microbein biofertilizer | 6.71                   | 6.84                   | 6.98     |
| Microbein + S.A. | 6.90                   | 7.03                   | 7.18     |
| Microbein + vit. C | 7.08                   | 7.22                   | 7.37     |
| Microbein + S.A. + vit. C | 7.31                   | 7.46                   | 7.61     |
| Mean (A)         | 6.71                   | 6.85                   | 7.00     |
| L.S.D. at 5 %    | A:0.09                 | B:0.12                 | AB:0.24  |
|        | A:0.12                 | B:0.14                 | AB:0.28  |

Lower floret weight (g)

| Treatments (B)   | 1st season (2018/2019) | 2nd season (2019/2020) | Mean (B) |
|------------------|------------------------|------------------------|----------|
| Control          | 5.56                   | 5.72                   | 5.89     |
| Salicylic acid (S.A.) | 5.74                   | 5.91                   | 6.08     |
| Ascorbic acid (vit. C) | 5.97                   | 6.14                   | 6.33     |
| Microbein biofertilizer | 6.18                   | 6.36                   | 6.55     |
| Microbein + S.A. | 6.41                   | 6.60                   | 6.80     |
| Microbein + vit. C | 6.64                   | 6.83                   | 7.04     |
| Microbein + S.A. + vit. C | 6.89                   | 7.09                   | 7.31     |
| Mean (A)         | 6.20                   | 6.38                   | 6.57     |
| L.S.D. at 5 %    | A:0.12                 | B:0.12                 | AB:0.24  |
|        | A:0.14                 | B:0.13                 | AB:0.26  |

on petunia, Osman (2016) on gerbera, Prasad et al. (2017) on lily, Hamid et al. (2017) on narcissus plant. A possible explanation to the positive effects of compost fertilizer treatments might be attributed to its stimulative effect on different vegetative growth (Khattab et al., 2017; Abbasi et al., 2020). Better vegetative growth should be directly reflected on various flowering aspects (Manzoor et al., 2019; Niazian and Nalousi, 2020).

Regarding Microbein biofertilizer (M.B.) and/or some antioxidant (salicylic acid and vitamin C) treatments and their combined, data in Tables (4 and 5) revealed that all seven used 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 were obtained due to the treatments of Microbein...
biofertilizer (M.B.) plus salicylic acid plus vitamin C.

These findings were similar to those obtained by Srivastava and Govil (2005), Kaushik et al. (2016), Pansuriya et al. (2018) and Chakradhar et al. (2019) on gladiolus, Khan et al. (2009) on tulip, Kumar et al. (2012) on tuberose plant.

These results might be attributed to the direct and/or indirect roles of substances (nutrients, amino acids, vitamins, auxins, cytokinin and gibberellins) (Spermat, 1990 and Nagodawithana, 1991), all those substances have better effects on the plant growth, consequently improving enzymatic system that reflected on the flowering of gladiolus. The role of salicylic acid treatments in increasing flowering aspects parameters was mentioned by Pawar et al. (2018) and Al-Hasnawi et al. (2019) on gladiolus, Ramtin et al. (2016) on carnation, Ahmad et al. (2018) and Nassour et al. (2019) on tuberose plant.

The role of ascorbic acid (vit. C) in promoting flowering was also discussed by Mehdikhah et al. (2016) on gerbera, Mohammed et al. (2016) on dahlia plant and Gaber (2019) on Pelargonium zonale plant. Antioxidants protect plants against damage resulting from aerobic metabolism, photosynthesis and a range of pollutants. It also acts as enzyme co-factor especially hydroxylase enzyme, electron transport, oxalate and tartarate synthesis (Bharaguva, 1991 and Mehdy, 1994; Khattab et al., 2017; Abbasi et al., 2020). The interaction between both experimental factors (factor A and factor B) was significant in both seasons for the studied flowering characters (Fig., 1).

Since the largest length of spike (season one 65.76 and season two 65.76), largest number of florets/spike (season one 11.65 and season two 11.98) and the highest lower floret diameter (season one 7.79 and season two 8.34) were achieved with compost (15 ton/fed) in combination with Microbein biofertilizer plus salicylic acid plus ascorbic acid and these traits are the most important characters for the quality of gladiolus, application of compost and Microbein plus ascorbic acid in combination is recommended. Gladiolus flowers have a high economic value, and if produced with high quality, suitable profitability will follow. In the production process of gladiolus, the quality of the flowers is related to length of spike, length and diameter of lower florets, number of florets/spike and vase life. The quality of vegetative growth parameters is also an important factor to determine the quality of the gladiolus flower (Khattab et al., 2017; Abbasi et al., 2020).

CONCLUSION

In Egypt, gladiolus is an important cut flower and the importance of gladiolus as a cut flower is increasing day by day in domestic and international exporting markets. Commonly, as stated by the results obtained by this research for important gladiolus flowering characters for instance the largest length of spike, largest number of florets/spike and the highest lower floret diameter, it seems that compost at the rate of 15 ton/fed in combination with Microbein biofertilizer plus salicylic acid plus ascorbic acid can be considered as the best treatment for gladiolus Jester variety production in Egypt. Additionally, this treatment improved gladiolus vegetative growth parameters such as leaf length (cm), number of leaves/plant, leaves dry weight/plant (g). Results of this research indicated that in most cases, the best overall results regarding vegetative growth and flowering aspects were obtained due to the use of compost at the high level (15 ton/fed) in combination with Microbein biofertilizer (M.B.) plus salicylic acid plus vitamin C followed by the high level of compost (15 ton/fed) with the two mixed of Microbein biofertilizer (M.B.) plus vitamin C then the medium level of compost (10 ton/fed) with the three mixed of Microbein biofertilizer (M.B.) plus salicylic acid plus vitamin C. Gladiolus corms of Jester variety (Gladiolus gradiflorus) agricultural adaptability to the Egyptian conditions is
Fig. 1. Quality parameters of gladiolus (length of spike (cm), number of florets/spike and lower floret diameter (cm) as affected by experimental treatments, compost 15 ton/fed + M.B. + S.A. + V.C (A4 x B7); compost 15 ton/fed + M.B. + V.C (A4 x B6); compost 10 ton/fed + M.B. + S.A. + V.C (A3 x B7).
increased as well as increasing high potentials of its flowers exporting.

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