Effect of methyl jasmonate and salicylic acid on the production of *Gladiolus grandifloras*, L.

Eman Sewedan, Amira R. Osman and Maneea Moubarak

Horticulture Department, Faculty of Agriculture, Damanhour University, Egypt
osmanami1@hotmail.com, Amira.ramadan@agr.dmu.edu.eg.

Abstract: This investigation was carried out during 2016 and 2017 seasons on *Gladiolus grandifloras*, L. grown in 25 cm diameter pots at faculty of Agriculture of Damanhour University in Damanhour City, El-Beheira Governorate, Egypt. The experimental design was a complete randomized block design in factorial experiment with three replicates. The aim of this work was to study the effect of different levels of methyl jasmonate at rates of (zero, 50, 75 and 100 ppm) and salicylic acidat rates of (zero, 50, 100 and 150 ppm) on the vegetative growth, flowering and Corm Production of *Gladiolus grandifloras*, L. From the obtained results it was concluded that treating *Gladiolus* plants with combination of salicylic acid at 150ppm and methyl jasmonate at 75 ppm improve the vegetative growth, flowering characteristics, Corm Production and the contents of total chlorophyll in the leaves of *Gladiolus* plants.
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1. Introduction

Gladiolus grandifloras, L. plants is belonging to family ***iridaceae*** and considered as one of the most important flowering bulb grown in Egypt used in decoration as a cut flower spike with relatively long vase life and as a landscape plant in gardens. There are fast increase in areas planted with *Gladiolus* in Egypt to meet the increase demand for *Gladiolus* flowers for local market and exporting, during winter and spring seasons. *Gladiolus* plants propagated by corm which is the food storing underground stem.

Methyl Jasmonate (MeJA), a methyl ester of **J**asmonic **a**cidis a plant growth regulator, fragrant volatile compound isolated from the flowers of *Jasminum grandiflorum* **(Jong-Joo Cheong and Yang Do Choi 2003)** and derived from linolenic acid. It is cyclopentanine-based compounds that occur naturally in many plant species. The level of JA in plants varies as a function of tissue and cell type, developmental stage, and in response to various environmental stimuli. For example, High JA levels are found in flowers and pericarp tissues of developing reproductive structures **(Creelman & Mullet, 1997)**. They can mediate gene expression in response to various environmental and developmental processes **(Wasternack & Parthier, 1997)**. JA also activates gene expression encoding proteinase inhibitors. Proteinase inhibitors are known antidigestive proteins that block the action of herbivore proteolytic enzymes **(Creelman & Mullet, 1997)**. MeJA has been utilized in the regulation of different plant developmental processes such as root growth, pollen production, plant resistance to insects, pathogens and some herbicides, as for example paraquat **(Wu et al. 2008).** Characterization of the gene encoding jasmonic acid carboxyl methyltransferase has provided basic information on the role (s) of this phytohormone in gene-activation control and systemic long-distance signaling. Recent approaches using functional genomics and bioinformatics have identified a whole set of MeJA-responsive genes, and provide insights into how plants use volatile signals to withstand diverse and variable environments. **(Jong-Joo Cheong and Yang Do Choi 2003).**

Salicylic Acid (SA) is classified as a type of plant hormone and produced from phenylalanine via coumaric and benzoic acid **(Ryals et al., 1996 and Sticher et al., 1997)**. Biosynthesis of SA starts with the conversion of phenylalanine to trans-cinnamic acid **(Sticher et al., 1997)**. From transcinnamic acid, either benzoic acid (BA) or ortho-coumaric acid are produced. Depending on its concentration, SA influences the growth, flower induction, ethylene synthesis and respiration **(Rajjou et al., 2006)** and development processes of plants such as by increasing the rmotolerance, stimulating adventitious root formation, resistance against biotic and abiotic stresses, and affecting nitrate metabolism and total chlorophyll content within plants **(Canacki 2008; Larqué-Saavedra and Martin-Mex 2007; Yildirim et al. 2008).**

Thus, the aim of this investigation was to examine the effect of foliar Salicylic Acid (SA) and Methyl Jasmonate (MeJA) as well as applications on bloom delay, flowering quality and quantity and Corm Production on *Gladiolus* plants.

2. Material and Methods

This work was carried out in the two successive seasons: 2016 and 2017 at faculty of Agriculture of Damanhour Universityin, Damanhour City, El-Beheira Governorate, Egypt. The corms of gladiolus (*Gladiolus hybrida* cv. *L.*) were bought from commercial nursery in Alexandria they imported corms from Holland for both seasons. Average corm diameter was 2.5 cm and 2.7 cm and corm fresh weight was 8.2 and 8.9 gm for the first season and second one, respectively. The soil of the experimental was mixture of sand and fine manure at the ratio of 3:1 by volume. The physical and chemical analysis of used soil are showed in table (1) were carried out in the soil testing laboratory, Agriculture of Damanhour University. Corms were planted in clay pots of 25 cm diameter at depth of 10 cm from the soil surface, in Nov. 1st in both seasons.

Sixteen treatments which are all the possible combinations of four levels concentration of methyl jasmonate, 95% $C_{13}H_{20}O_3$ from SIGMA- ALDRICH product of Japan (0, 50, 75 and 100 ppm) and salicylic acid (0, 50, 100 and 150 ppm). The concentrations of methyl jasmonate and salicylic acid were sprayed early in the morning four times where the first one was sprayed to plants one month after planting. The other doses were sprayed at 45, 60, 75 days from planting time on plant foliage until the run off point. All experimental pots received fertilization dose (1.5 g N + 2.5g P_2O_5 + 1.2g K_2O / plant) as recommended by (**Hogan. L., 1990).** Ammonium nitrate (33% N), calcium superphosphate (16% P_2O_5) and potassium sulfate (48% K_2O) fertilizer, were used as source for N, P and K. Mono calcium phosphate and potassium sulfate fertilizers were mixed with the used medium for all plants just before planting. Ammonium nitrate fertilizer was added at two equal parts after 2 and 8 weeks from planting. Mg and Fe fertilizers were sprayed three times at three weekly intervals on plant foliage until the run off point at 150 and 75 ppm, respectively **(Epstein E., 1972).** The following data were recorded: Plant height (cm), Leaves area per plant (cm^2), Leaves dry weight (g), Number of florets per spike, Florets diameter (cm), Spike length (cm), Flowering time (days), Flowering duration (days), Corm Diameter (cm), Corms Dry Weight (gm) and Total Chlorophyll Content of leaves (mg/100gm) according to **(Rami, M. and D. Porath, 1980)**.

The experimental design was a complete randomized block design in factorial experiment with three replicates each replicate contained three plants. Data were subjected to analysis of variance (ANOVA) using the SAS program **(SAS Institute, 2002)**. And the mean values were compared using Tukey´s test at L.S.D 0.05 level **(Snedecor, G. and W. Cochran, 1974).**

Table 1: Mechanical analysis and some chemical properties of the used growth medium.

Mechanical analysis				chemical properties			
Clay%	Silt%	Sand%	Soil texture	pH	EC (ds/m)	N (ppm)	P (ppm)
3.2	2.9	93.9	Sandy soil	7.5	1.8	95	21

3. Results and Discussion

Vegetative Growth characters:

Generally, data on means of plant height, leaves area per plant and leaves dry weight of two seasons in Table (2) showed that, using foliar Salicylic Acid (SA), Methyl Jasmonate (MeJA) and interactions between them led to significantly increase the plant height, leaves area per plant and leaves dry weight of gladiolus plants compared with control. The greatest means values of two seasons for three vegetative growth characters (121.05 cm, 375.8cm^2 and 6.3 gm, respectively) were found by using Salicylic Acid (SA) at150 ppm with Methyl Jasmonate (MeJA) at 75 ppm. The increase of vegetative growth characters resulting from using treatments may be due to the increasing amount of the added Salicylic Acid (SA) which led to increase the amount of absorbed and translocated (SA) within the plants. Besides, (SA) is an important compound influences the growth and development processes of plants such as by increasing the rmotolerance, stimulating adventitious root formation, resistance against biotic and abiotic stresses, and affecting nitrate metabolism and total chlorophyll content within plants then increasing many biological processes **(Canacki 2008; Larqué-Saavedra and Martin-Mex 2007; Yildirim et al. 2008)**.

Besides, positive regulatory role of salicylic acid on stomatal closure which regulates the rates of transpiration and increases the water retaining capacity of leaf and petal **(Mori et al., 2001)**. The Salicylic Acid (SA) have the ability to prevent the environmental stress damage on plant growth, flower induction, uptake of ions and to increase the leaves area by increasing cell elongation and expansion then increase the photosynthesis efficiency and thus the biosynthesis of proteins and carbohydrates could be increased, leading to increase the leaves number and size thus the accumulation of dry matter in the leaves could be increased. These results are agreement with those obtained by **Khodary (2004)** observed a significant increase in growth characteristics, pigment contents and photosynthetic rate also enhanced the carbohydrate content in maize, sprayed with SA. **Hussein et al. (2007)** in their pot experiment sprayed salicylic acid to the foliage of wheat plants, reported an enhanced productivity due to an improvement in all growth characteristics including plant height, number and area of green leaves, stem diameter and dry weight of stem, leaves and of the plant as a whole.

Also, the role of the plant growth regulator (phytohormone) such as Methyl Jasmonate (MeJA) in stimulating growth of several plant species **(Jong-Joo Cheong and Yang Do Choi 2003)** the level of (MeJA) in plants varies as a function of tissue and cell type, developmental stage, and in response to various environmental stimuli. For example, High (MeJA) levels are found in flowers and pericarp tissues of developing reproductive structures **(Creelman & Mullet, 1997)** and indicated that the increase in growth as a result of application of (MeJA) may be due to activates gene expression encoding proteinase inhibitors and plants use volatile signals to withstand diverse and variable environments **(Jong-Joo Cheong and Yang Do Choi 2003).**

Increasing MeJA concentrations at 100 ppm led to significantly decrease in means values of two seasons of the plant height, leaves area per plant and leaves dry weight of gladiolus plants (113.65 cm, 331.7 cm^2 and 5.1 gm, respectively) compared with MeJA concentrations at 75 ppm (116.6 cm, 338.7cm^2 and 5.4 gm, respectively). One previous study reported that increasing MeJA concentrations may inhibited root growth in some species **(Lois et al., 1989).**

The mixed treatment of SA with MeJAin two seasons seemed to be more effective than either treatment alone. In conformity with these results were agreement with those obtained by **Yingbin et al., (2016)** reported that, SA had different effects on MeJA-promoted leaf senescence depending on the concentrations at which it was applied and the gradual loss of chlorophyll content and photochemical efficiency in the leaves treated with SA+MeJA was less severe relative to that of the leaves treated with MeJA alone, low concentrations of SA provide protection against senescence caused by MeJA.

Table (2): Means of plant height (cm), leaves area per plant (cm^2) and leaves dry weight (gm) of *Gladiolus hybrida*, cv. *L.* as influenced by the different levels of methyl jasmonate (MeJA), salicylic acid (SA) and their interaction (MeJA×SA) in the two seasons of 2016 and 2017.

salicylic acid (SA)	methyl jasmonate (MeJA) (ppm)					methyl jasmonate (MeJA) (ppm)				
	Control	50	75	100	Mean	Control	50	75	100	Mean
	2016 Season					2017 Season				
	Plant height (cm)					Plant height (cm)				
Control	74.7j	97.4h	115.3c	108.5ef	99D	74.1j	97.6h	116.1c	108.7e	99.1D
50	92i	98.8h	110.8de	118bc	104.9C	91.7i	98.9h	110.9d	118.3b	105C
100	101.9g	102.6g	118.8ab	115.5c	109.7B	101.7g	102.7g	118.7b	115.8c	109.7B
150	112d	106.7f	121.2a	112.1d	113A	112d	106.9f	120.9a	112.4d	113A
Mean	95.2D	101.4C	116.5A	113.5B		94.9D	101.5C	116.7A	113.8B	
	Leaves area per plant (cm^2)					Leaves area per plant (cm^2)				
Control	246.1m	273.2k	308.4f	297.5h	281.33D	244.5fg	273.4defg	308.3bcdef	297.4bcdef	280.9D
50	265l	287.6j	328.7e	355.9b	309.3C	266.4efg	287.9cdef	328.6abcde	355.4ab	309.6C
100	290.7i	301.2f	341.6c	341.8c	318.8B	290.8bcdef	302.5bcdef	342.3abc	341.9abc	319.4B
150	302.1g	310	375.8a	332d	330A	302.7g	309.6bcdef	375.8a	332.2abcd	330.1A
Mean	276D	293C	338.6A	331.8B		276.1C	293.3B	338.8A	331.7A	
	Leaves dry weight (g)					Leaves dry weight (g)				
Control	3.18n	3.8l	4.8g	4.3j	4D	3.17j	3.5i	4.7f	4.3gh	3.9D
50	3.72m	4.2k	5e	6.1b	4.7C	3.6i	4.2gh	5de	6.1b	4.7C
100	4.2k	4.4i	5.5c	5.6c	4.9B	4.2gh	4.4g	5.5c	5.7c	4.9B
150	4.7h	4.9f	6.3a	5.1d	5.3A	4.8f	4.9ef	6.3a	5.1d	5.3A
Mean	3.9D	4.3C	5.4A	5.3B		3.9D	4.2C	5.4A	5B	

*Values marked with the same letter (s) within the main and interaction effects are statistically similar using LSD test at P = 0.05. Uppercase letter (s) indicate differences between main effects, and lowercase letter (s) indicate differences within interactions of each character. methyljasmonate (MeJA), salicylic acid (SA)

Flowering Characteristics:

Flowering Time (days):

Data in table (3) showed that flowering time (number of days from planting till the opening of the first floret) was significantly increased from foliar Salicylic Acid (SA), Methyl Jasmonate (MeJA) and their interaction on gladiolus plants compared with control. The interaction of (SA) at 150 ppm and (MeJA) at 75 ppm had the greatest significant effect on bloom delay in means values of Flowering Time for both seasons (113.5 days) in comparison to their individual (SA) at 150 ppm (105 days) and (MeJA) at 75 ppm (107 days). These results are in agreement with those obtained by **(Sekozawa et al., 2003; Rohwer and Erwin, 2008)** they reported that the exogenous application of (SA) and (MeJA) altered balances of the auxin, cytokinin and Abscisic acid (ABA) in plants, which cause delay in blooming. **(Ding et al., 2001)** observed, (SA) prevented the decrease in IAA and cytokinin content completely from shoots and roots which reduced stress-induced inhibition of plant growth. However, in the present study with (SA) and (MeJA) application, may be accumulation of ABA in gladiolus plants have caused bloom delay **(Rohwer and Erwin, 2008 and Zarghami et al. 2014).**

Number of Florets, Florets Diameter and Spike length:

Gladiolus plants treated with (SA) and (MeJA) in this study significant increase in Number of Florets, Florets Diameter and Spike length (Table 3). The greatest means values for both seasons was recorded in the plants sprayed by combination with (SA) at 150 ppm and (MeJA) at 75 ppm (16.6 florets /spike, 9.9 cm and 96 cm, respectively) followed by (MeJA) at 75 ppm (14.1 florets /spike, 8.8 cm and 86.8 cm, respectively) then (SA) at 150 ppm (13.3 florets /spike, 8.2 cm and 84.9 cm, respectively).

Gladiolus plants treated with (SA) and (MeJA) in this study escaped the decrease of temperature by bloom delay. These may be cause of the increase of Number of Florets, Florets Diameter and Spike length. These results are in accordance with the results of other researchers **(Karlidag et al., 2009; Eetezaz et al., 2011)** who showed increase of flowering and yield in strawberry and *Cucumismelo* by treatment with MeJA and SA. **(Tooba et al., 2014)** reported that, salicylic acid and jasmonic acid treatments are able to increase significantly number of flower, diameter of flower and stalk length in rose. **Eetezaz et al. (2011)** in *Cucumis melo* L**. and Jabbarzadeh et al. (2009)** on African Violet noticed that (MeJA) and (SA) induced flowering by acting as a chelating agent.

Flowering Duration (days):

Flowering Duration (number of days from opening of the first floret till the wilt of the florets) improved significantly with the application of (MeJA) and (SA) or their combinations at the both seasons compared to the control treatment. The longest in means values of Flowering Duration for both seasons was recorded in the plants sprayed by combination with (SA) at 150 ppm and (MeJA) at 75 ppm (18 days) followed by (MeJA) at 75 ppm (14.9 days) then (SA) at 150 ppm (14 days) and they were significantly different when compared to other treatments (Table 3). MeJA and SA are plant hormones that inhibit ethylene biosynthesis and delay senescence **(Christelle et al., 2001)**.

Improving Flowering Duration could be interpreted as the role of (SA) as an endogenous growth regulator which plays an important role in increasing antioxidant content and promotes cell division, cell enlargement then application of (SA) increased the leaf area of treated plants which reflected on the flower quality and quantity **(Hayat and Ahmad, 2007).** (**Karlidag *et al*. (2009) and Kazemic *et al.* 2017),** reported that, (SA) decreased catalase and peroxidase with concomitant increase in glutathione reductase which play a role as an antioxidant.

MeJAplays multiple roles in general developmental processes related to flower opening, bud initiation and Flowering Duration **Barendse *et al*. (1985), Maciejewska *et al*. (2004) and Krajncic *et al*. (2006) on** *Pharbitis nil* and *Nicotiana tabacum*.

Corm Production and Chemical Analyses:

Corm Diameter (cm) and Corms Dry Weight (gm):

The data in table (4) during both seasons indicated that Corm Diameter and Corms Dry Weight were significantly increased with increasing (SA) levels, in comparison with untreated plants. However, non-significant differences were detected in Corms Dry Weight between the treatments of (MeJA) at 75 ppm and 100 ppmin the two seasons. The highest mean values for all corm production (Corm Diameter and Corms Dry Weight) in both seasons were obtained (5.9 cm and 5.17 gm, respectively) by using Combination with (SA) at 150 ppm and (MeJA) at 75 ppm.

The increase in corm production was attributed to the improving the vegetative growth which reflected on increasing the underground organs of Gladiolus plants especially when added in suitable combinations with (SA) and (MeJA), and promoting leaves production table (2), as well as, stimulating Chlorophyll and better photosynthesis table (4) is reflected by sequence on more total sugars and dry matter accumulation, in addition to increase in corm production. Similar observation were pointed out, Jasmonates influence storage organ formation. Exogenously applied jasmonates induce or promote tuber formation in potato **(Bazabakana., 2003),** and orchid **(Debeljak., 2002),** as well as bulb formation in garlic **(Ravnikar., 1993)** and narcissus **(Santos and Salema 2000).** The putative role of jasmonates in storage organ formation has been corroborated by reports on increased endogenous levels of jasmonates in bulb- and tuber-forming plants **(Helder., 1993).** Among the morphogenetic processes affected by salicylic acid are flowering and tuberization; e.g., salicylic acid induces tuberization in potato **(Koda., 1992)** and enhances flowering in *Lemna* **(Khurama and Cleland, 1992).**

Total Chlorophyll Content (mg/100gm):

The content of total Chlorophyll in fresh leaves of *Gladiolus* plants was significantly promoted due to Salicylic Acid (SA), Methyl Jasmonate (MeJA) and their interaction, in two seasons, in comparison with those of untreated plants as shown in table (4). Combination with (SA) at 150 ppm and (MeJA) at 75 ppm gave the highest values for total Chlorophyll pigments in both seasons, followed by (MeJA) at 75 ppm then (SA) at 150 ppm and they were significantly different when compared to other treatments. This result may be attributed by regulating the plant water which carry nutrient elements especially N and P that reflected on increasing total chlorophyll content. In harmony with results were reported by **(Tooba et al., 2014)** on rose flowers. Similar results were obtained by **(Jahanbazi *et al.*, 2014)** by using salicylic acid onrose (cv. 'Angelina').

Table (3): Means of flowering time (days), number of florets per spike, florets diameter (cm), spike length (cm) and flowering duration (days) of *Gladiolus hybrida*, cv. *L.* as influenced by the different levels of methyl jasmonate (MeJA), salicylic acid (SA) and their interaction (MeJA×SA) in the two seasons of 2016 and 2017.

salicylic acid (SA)	methyl jasmonate (MeJA) (ppm)					methyl jasmonate (MeJA) (ppm)				
	Control	50	75	100	Mean	Control	50	75	100	Mean
	2016 Season					2017 Season				
	Flowering time (days)					Flowering time (days)				
Control	88.7g	103.2d	100.4e	100.7e	98.3C	88.1g	103.5	100.7	100.8	98.4C
50	91.7f	99e	103d	103.4d	99.3C	92.2f	97.8e	103d	104.2d	99.5C
100	99.1e	94f	110.9b	108c	103B	99.3e	92.6f	111.1b	107.9c	102.7B
150	92.7f	103.1d	113.3a	109.9bc	105A	93f	103.9d	113.8a	109.5bc	105A
Mean	93.1D	100C	106.9A	105.5B		93.1D	99.4C	107.1A	105.6B	
	Number of florets per spike					Number of florets per spike				
Control	7j	9.3hi	11.6ef	9.2hi	9.3C	6.8h	9.1g	11.1ef	8.8g	9C
50	8.5i	10.6fg	14c	15.3b	12.1B	8.6g	10.8ef	14bc	15b	12.1B
100	9.7gh	12.2de	15.5b	14.1c	12.9A	9.7fg	12.3de	13.6bcd	14.1bc	12.4AB
150	10.7f	13d	16.7a	12.4de	13.2A	10.7ef	13.4bcd	16.6a	12.7cd	13.4A
Mean	9D	11.3C	14.4A	12.7B		9D	11.4C	13.8A	12.7B	
	Florets diameter (cm)					Florets diameter (cm)				
Control	4.8j	6.6h	8.1de	7.2fg	6.7C	4.6j	6.6hi	8.1def	7.4fg	6.7C
50	5.6i	6.1i	8.2d	9.4b	7.3B	5.9i	6i	8.33cd	9.2b	7.4B
100	7.2fg	6.8gh	8.8c	8.8c	7.9A	7.3gh	6.9gh	8.8bcd	8.9bc	8A
150	8de	7.2fg	9.9a	7.6ef	8.2A	8.3cde	7.3gh	10a	7.5efg	8.3A
Mean	6.4D	6.7C	8.8A	8.2B		6.5C	6.7C	8.8A	8.3B	
	Spike length (cm)					Spike length (cm)				
Control	53.4l	70j	78.9f	74.6i	69.2D	53.7j	70.3h	78.5f	74.3g	69.2D
50	66.9k	70.6j	83.5e	93.1b	78.6C	67.1i	70.5h	83.7e	93.1b	78.6C
100	76.9gh	75.3hi	89.1c	90.4c	82.9B	77.5f	75.4g	88.9c	90.5c	83.1B
150	78.6fg	78.7f	95.9a	86.7d	85A	79f	78.3f	96.1a	86d	84.8A
Mean	68.9C	73.7B	86.9A	86.26A		69.3C	73.6B	86.8A	86A	
	Flowering duration (days)					Flowering duration (days)				
Control	6.7j	10.8h	13.7de	12.3fg	10.9D	6.7j	11g	13.6	11.8fg	10.8D
50	9i	9.11i	13ef	16.4b	11.9C	9i	9.6hi	12.8ef	16.7b	12C
100	10.7h	10.5h	14.8c	14.8c	12.7B	11.3g	10.6gh	15.3c	14.5cd	12.9B
150	12.5f	11.6g	17.9a	14.4cd	14.1A	12.7ef	11.7fg	18.1a	13.6de	14A
Mean	9.7C	10.5B	14.8A	14.5A		9.9D	10.7C	15A	14.1B	

*Values marked with the same letter (s) within the main and interaction effects are statistically similar using LSD test at P = 0.05. Uppercase letter (s) indicate differences between main effects, and lowercase letter (s) indicate differences within interactions of each character. methyljasmonate (MeJA), salicylic acid (SA)

Table (4): Means of Corm Diameter (cm), Corms Dry Weight (gm) and Total Chlorophyll Content of leaves (mg/100gm) of *Gladiolus hybrida*, cv. *L.* as influenced by the different levels of methyl jasmonate (MeJA), salicylic acid (SA) and their interaction (MeJA×SA) in the two seasons of 2016 and 2017.

salicylic acid (SA)	methyl jasmonate (MeJA) (ppm)					methyl jasmonate (MeJA) (ppm)				
	Control	50	75	100	Mean	Control	50	75	100	Mean
	2016 Season					2017 Season				
	Corm Diameter (cm)					Corm Diameter (cm)				
Control	2.2k	3.1ij	4.1def	3.3hi	3.2D	2.2i	3.2h	4e	3.5g	3.2D
50	2.9j	3.1ij	4.4cd	5.2b	3.9C	3h	3.1h	4.4d	5.2b	3.9C
100	3.6gh	3.7fg	4.9b	4.9b	4.3B	3.7fg	3.7fg	4.9c	5bc	4.4B
150	4.2de	3.9ef	6a	4.6c	4.6A	4.1e	3.9ef	5.9a	4.5d	4.7A
Mean	3.2D	3.5C	4.8A	4.5B		3.3D	3.5C	4.8A	4.6B	
	Corms Dry Weight (gm)					Corms Dry Weight (gm)				
Control	1.8j	3.2h	4ef	3.5g	3.1D	1.8k	3.3h	4.2e	3.7	3.2D
50	2.7i	3hi	4.1de	4.9ab	3.6C	2.7j	3i	4f	4.9b	3.6C
100	3.1h	3.2h	4.46c	4.7bc	3.8B	3.1i	3.3h	4.5d	4.7c	3.9B
150	3.8efg	3.7fg	5.15a	4.42cd	4.2A	3.8g	3.7g	5.2a	4.4d	4.3A
Mean	2.8C	3.3B	4.4A	4.4A		2.9C	3.3B	4.5A	4.4A	
	Total Chlorophyll Content of leaves (mg/100gm)					Total Chlorophyll Content of leaves (mg/100gm)				
Control	157.4l	204.1j	273.4g	252.5i	221.9D	155.5m	206k	273.9h	249.4j	221.2D
50	176.7k	261.9hi	335.3bc	345b	279.7C	176.2l	262.1i	337.3cd	344.6bc	280.1C
100	264.2gh	301.2f	345.7b	327.8cd	309.7B	265.6hi	300.7g	349.8b	328.9de	311.3B
150	273.5	321.2de	368.9a	312.8e	319.1A	273.4h	323.8e	369.2a	313f	319.9A
Mean	217.9D	272.1C	330.8A	309.5B		217.7D	273.2C	332.5A	309B	

*Values marked with the same letter (s) within the main and interaction effects are statistically similar using LSD test at P = 0.05. Uppercase letter (s) indicate differences between main effects, and lowercase letter (s) indicate differences within interactions of each character. methyljasmonate (MeJA), salicylic acid (SA)

Conclusions

In accordance with the results, (MeJA) and (SA) can be recommended to delay bloom in Gladiolus plants and may be other flowering bulbs growing in winter in Egypt. However, the present study is the first evidence of the effect of (MeJA) and (SA) on bloom delay, flowering quality and quantity and Corm Production of Gladiolus plants.

Corresponding Author:
Amira R. Osman
Horticulture Department, Agriculture Faculty, Damanhour University, Egypt.
E-mail: osmanami1@hotmail.com, amira.ramadan@agr.dmu.edu.eg.

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