Effect of Some Chemicals on Vase Life of Gladiolus Cut Flowers

Mahmoud Khattab[1], Mohammed El-Torky[1], Abd-El-Hamid Torabeih[2], Hend Rashed[1]

ABSTRACT

The present study was carried out during two seasons of 2015/2016 under laboratory conditions in the Department of Floriculture, Ornamental Horticulture and Garden Design Faculty of Agriculture, University of Alexandria at Shatby and Behira Governorate (Abo El-Matameer city) to investigate the possibility of opening the florets of the cut spikes of *Gladiolus grandiflorus cv."White Prosperity"* at show color stage, inflorescence keeping quality, leaves chemical analysis and the growth of microorganisms in the vase solution using three concentrations of each of ascorbic acid (150,200,and 250 ppm),boric acid (30,60 and120 ppm),glycine amino - acid (20,40 and 80 ppm) and 5-salfosalicylic acid (100,200 and 300 ppm). Results indicated that all the used acids had positive effects on the keeping quality of cut *Gladiolus* spikes and using boric acid at level ranged between 30 to 120 ppm to the vase solution led to increase the florets diameter, duration period and inhibit the growth of microorganisms in the vase solution. While using 5-salfosalicylic acid at 100-200 ppm gave a fast opening of the florets, increased the number of the opened florets, decreased the number of the non-opened florets per spike and increased the amount of the absorbed vase solution.

keyword: Gladiolus, Keeping quality.

INTRODUCTION

Gladiolus (*Gladiolus grandiflorus* L.) is an important bulbous ornamental crop among the elite cut flowers due to their different shapes and hues and excellent vase life (Bose *et al*.2003). It is valued for its wide range of flower colours and large number of florets per spike, and popular as cut flower in the domestic and international market. It is one of the four famous cut flowers in the world (Bai *et al*. 2009).

Vase-life is a yardstick for the longevity of cut flowers and is an important target for improving flower characteristics, whether by chemical treatment or plant breeding (Yamada *et al.* 2003).

Short postharvest vase life is one of the most important problems on the cut flowers. The maintenance of vase life is an important quality attribute in these economically significant cut flowers. A suitable method for vase life extension, which easy to use, natural, safe and inexpensive compounds is always crucial in this respect for large-scale applications.

Vase life of cut flowers is mainly affected by two main factors, namely ethylene which accelerates the senescence of many flowers and microorganisms which cause vascular blockage and thus reduce the amount of water uptake, consequently the vase life of cut flowers could be reduced (Zencirkiran, 2010).

The water balance is also a major factor determining the quality and longevity of cut flowers. It is influenced by water uptake and transpiration and balance between two mentioned processes (Da Silva, 2003).

Ascorbic acid ($C_6H_8O_6$ "vitamin C") plays a role in electron transport system (El-Kobisy *et al.* 2005). Ascorbic acid also has been associated with several types of biological activities in plants such as in enzyme co-factors, antioxidant, and as a donor / acceptor in electron transport at the plasma membrane or in the chloroplast (Conklin, 2001).

Boric acid ($B(OH)_3$ or $H_3\ BO_3$) is another compound which delays senescence of some flowers such as carnation (Serrano *et al.*2001) and it inhibits ethylene production through reducing ACC synthase and ACC oxidase activities.

Glycine ($C_2H_5NO_2$) is the most common amino acid used in plant uptake studies and is thought to be particularly important as a nitrogen source for plants because of its low-molecular weight, low carbon-to-nitrogen ratio and it inhibits the apparent photorespiration done by C_3 (Zeiger, 2010). It stimulates the synthesis of chlorophyll and it activates the vegetative growth and it has a role in the process of photosynthesis and handling stressful situations that occur after the flowers picked.

5-sulfosalicylic acid ($C_7H_6O_6S$) is the salicylic acid (SA)-driven compound with sulfur group which may act more effective than SA because of its probable antimicrobial effect. Salicylic acid is an endogenous growth regulator of phenolic nature, which participates in the regulation of physiological processes in plants. SA can prevent ACC-oxidase and extend the vase life of cut flowers by decreasing reactive oxygen species (ROS) and ethylene (Zamani *et al.* 2011).

Therefore, the present work aimed to study the effects of various concentrations of ascorbic acid, boric acid, glycine amino-acid and 5-sulfosalicylic acid on the vase life and the growth of the microorganisms in the

[1]Fac.Agric. Alex.Uni. Depart. Of Flori.Ornam.Hort.and Landscape Gardening
[2]Plant Pathology.
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vase solution of gladiolus cut flowers at showing color stage under laboratory conditions.

MATERIALS AND METHODS

The present study included three experiments and they were conducted during two successive seasons of 2015 and 2016 at two different locations of Department of Floriculture ,Ornamental Horticulture and Garden Design Faculty of Agriculture University of Alexandria at Shatby and Behira governorate (Abo-El-Matameer city) under room conditions to investigate the effects of different concentrations of ascorbic acid (150,200 and 250), boric acid (30,60 and 120), glycine acid (20,40 and 80) and 5-sulfosalicylic acid (100,200 and 300) on the vase life, the growth of microorganisms in the vase solution and some chemical analysis of cut gladiolus spikes.

The used cut flower was *Gladiolus grandiflorus* cv. "White Prosperity" for its popularity in Egypt flower-trade. The flowers were obtained from a commercial nursery for flowers and ornamental plants in the outskirts of Cairo city.

The spikes were harvested early in the morning at showing color stage of the three basal florets, then they were quickly brought to the laboratory on 2/4/2015, 11/2/2016 and 25/2/2016 for the first, second and third experiment, respectively. All spike stems were trimmed to have an average spike length of 85 cm., 3-4 leaves and about 15 flower buds/spike.

Clean glass bottles were used as containers for the solution. Tap water was used in the preparation the holding solution and this solution was not changed or substituted until the end of the experiment. The volume of the holding solution was 780 ml for each bottle. Control treatment contained 780 ml tap water + 4 % sucrose (Ezhilmathi *et al*. 2007) while the other treatments contained 780 ml tap water +4% sucrose + specific chemical and its concentration.

Mean temperature was 19^{oc} ($\pm$ 2^{oc}) for the first experiment,18^{oc} ($\pm$ 2^{oc}) for the second experiment and it was 20^{oc} ($\pm$ 2^{oc}) for the third experiment. While the averages of the relative humidity were 74 % during the first experiment, 80 % during the second experiment and 72 % during the third experiments. The average of the light intensity for the three experiments was 733 lux.

At the end of the experiment, isolation trials from the vase- solutions of the different treatments were made by thoroughly shaking the solution of each treatment. One ml of each treatment was isolated on the surface of potato dextrose agar medium (PDA) by using sterilized one ml pipette. The inoculated plates were kept at room temperature (22^{oc} $\pm$ 2^{oc}). Each treatment was replicated three times. Examination of the inoculated petri-dishes was done every three days for a period of 15 days to know the developing microorganisms. The developed microorganisms were purified by using single spore isolation technique (Hildebrand, 1938) and they were identified to the generic level.

Data collected were floret full opening period (day), percentage of the opened florets per spike, number of the opened florets /spike, number of the non-opened florets /spike, floret diameter (cm), floret duration period (day), inflorescence duration (vase-life) (day), florets dry weight (g), total chlorophyll content (SPAD units) at the end of the experiment, total carbohydrates content (%), protein content (%), amount of absorbed vase solution per spike (ml/day) and colony number of the isolated microorganisms.

The experimental layout was designed to provide randomized complete blocks design (RCBD) containing three replicates, each replicate contained 13 different treatments, and three inflorescences were used as a plot for each treatment in each replicate. The means of the individual factors were compared by L.S.D test at 5% level of probability (Steel and Torrie,1980).

RERSULTS AND DISCUSSION

Floret full opening period (day):

Generally, means of data of the three experiments presented in Table 1 indicated that using boric acid at 30 ppm gave the longest period required for florets to reach their full opening stage, compared with the other treatments, while using 5-sulphosalicylic acid at 200 ppm gave the shortest period which required for florets to reach their full opening stage, compared with the other treatments.

These results were probably due to the role of using boric acid at a specific concentration in plant. Using boric acid at a proper concentration probably led to delay the florets senescence through a strong inhibition of ethylene production (Serrano *et al*.2001), beside it activates photosynthesis process (Dale and Lukaszewski, 1998), consequently the florets development rate required a longer period. While 5-sulfosalicylic acid has a crucial role in the regulation of physiological and bio-chemical processes during the entire life span of the plants and plays key roles in regulation their growth and productivity (Arbeg, 1981). Besides it modulates the synthesis and /or signaling of their hormones such as jasmonic acid, ethylene, and auxin (Raskin, 1992). All these factors probably led to accelerate the rate of the florets development, consequently, the required period for florets to reach their full opening stage could be reduced.

Similar trend of results was reported by Gargi and Devi (2005) and Parmer *et al*. (2002) on *Gladiolus*.

Percentage of the opened florets per spike:

Data presented in Table 1 showed that all the used four acids with their concentrations gave significant increases in the percentage of the fully opened florets / spike, compared with the control treatment. Besides, using 5-sulfosalicylic acid at 200 ppm gave the maximum percentage of the fully opened florets per inflorescence, compared with the other treatments, which led to increase the percentage of the fully opened florets with 28.02% over the control treatment (means of the three experiments).

These results may be probably due to the effect of adding 5-sulfosalicylic acid at a suitable concentration to the holding solution on enhancing the level of photosynthetic pigments, photosynthetic rate and modification the actively of some of the important enzymes as well (Yusuf *et al*.2013). Consequently, the production and accumulation of the bio-synthesis materials would be increased in the cut gladiolus spike, thus more florets could be developed and opened on the spike.

Similar trend of results was reported by Ezilmathi *et al*. (2007) on *Gladiolus* flowers, Rasul *et al*. (2011) on *Gladiolus* flowers and Nasibi *et al*., (2014) on tuberose.

Number of the opened florets per spike:

Generally, data of means of the three experiments presented in Table 1 showed that all the used materials led to increase the number of the fully opened florets per inflorescence of cut gladiolus spikes, compared with the control treatment. Besides, adding 5-sulfosalicylic acid at 200 ppm to the holding solution gave the maximum number of the fully opened florets per inflorescence, compared with the control treatment, which led to increase the number of the fully opened florets with 15.69% over the control treatment.

These results may be probably due to that using 5-sulfosalicylic acid at a suitable concentration in vase solution led to decrease the respiration rate (Ezhilmathi *et al*. 2007), delay senescence (Mackay *et al*. 2000), activate photosynthesis rate (Senaratna *et al*. 2000) and increase the vase solution uptake (Alaey *et al*. 2011). All these attributes led to increase the cumulative synthesis materials in the cut gladiolus spikes, consequently the number of the fully opened florets per inflorescence could be increased.

Similar trend of results was reported by Rao and Ram (1982) on *Gladiolus sp.* and EL-Mokadem (1991) on bird of paradise.

Number of the non-opened florets per spike:

Generally, data of means of the three experiments presented in Table 2 indicated that all the used acids led to decrease the number of the non-opened florets per gladiolus cut spike, compared with the control treatment. Also, adding 5-sulfosalicylic acid at 200 ppm to the vase solution gave the minimum number of the non-opened florets per inflorescence, compared with the other treatments. The previous treatment led to decrease the number of non-opened florets per cut gladiolus spike with 55.85 % under the control treatments.

These results were probably due to that using 5-sulfosalicylic acid at suitable concentration in the vase solution led to activate photosynthesis rate (Senaratna *et al*., 2000), increase the vase solution uptake (Alaey *et al*., 2011). All these factors led to increase the cumulative synthesis materials in the cut gladiolus spikes, consequently most of the inflorescence florets could be opened, then the number of non-opened florets per spike would be decreased.

Similar trend of results was reported by Khattab *et al*. (1988) on *Gladiolus sp*.

Florets diameter (cm):

Data of means of the three experiments presented in Table 2 showed that using boric acid at 60 ppm gave the biggest florets diameter of gladiolus plant, compared with the other treatments. The aforementioned treatments led to increase the florets diameter with 28.32% over the control treatment.

These results may be probably due to the role of boric acid at a proper concentration in plants. Boric acid increases chlorophyll content in the leaves (Raffeii and Pakkish, 2014), delay the senescence of flowers (Serrano *et al*.2001) and it can act in regulation of metabolism processes such as protein synthesis, transport of sugar and carbohydrate metabolism (Abd Elmotty and Fawzy,2005), accordingly, the net assimilation rate in gladiolus cut spikes would be increased, thus the flower quality could be improved.

Similar trend of results was reported by Mohammadi *et al*. (2014) on *Gladiolus* and Asgari and Moghadam (2015) on gerbera flowers.

Floret duration period (day):

Generally, data on means of the three experiment presented in Table 2 indicated that all the used materials led to increase the period of floret duration, compared with the control treatment. Besides, adding boric acid at 120 ppm to the vase solution gave the maximum period of floret duration of cut gladiolus spike, compared with the other treatments. The previous treatment led to extend the floret duration period with 65.49% over the control treatment. These results may be due to that adding a suitable concentration of boric acid led to delay floret senescence and inhibit of ethylene production through reducing ACC-synthase and ACC-oxidase activities in cut flowers, consequently the period of floret duration could be increased.

Table 1. Effect of the concentrations of the used acids on means of floret full opening period (day), percentage of the opened florets/spike, and the number of the opened florets/spike of *Gladiolus grandiflorus* cv."White Prosperity" during the two seasons (2015 and 2016).

Used acids	Concentrations (ppm)	Characteristics								
		Floret opening period (day)			Percentage of opened florets / spike			Opened florets number/spike		
		Shatby 2015	Shatby 2016	Behira* 2016	Shatby 2015	Shatby 2016	Behira* 2016	Shatby 2015	Shatby 2016	Behira* 2016
Control	0	3.00bc	3.00bc	2.00	75.25	56.61c	61.27b	9.64	11.40	9.55
Ascorbic	150	4.33	4.67ab	1.67	80.37	67.26bc	75.74a	11.86abc	10.97b	11.66ab
	200	3.00	3.33abc	1.00	81.43	71.25ab	67.12ab	9.40e	11.97ab	10.66bc
	250	5.33	3.67abc	1.00	83.17	70.75ab	64.83b	10.43cde	12.30ab	10.22cd
Boric	30	4.00	5.33a	2.00	91.57	73.49ab	62.13b	12.12ab	12.97a	9.55cd
	60	4.33	2.67bc	1.67	92.60	77.60ab	67.97ab	11.03bcd	11.63ab	10.11cd
	120	4.00	3.33abc	1.67	94.53	75.09ab	70.70ab	11.64abc	12.20ab	10.55bc
Glycine	20	4.66	4.33abc	1.33	76.24	79.89a	64.84b	11.96abc	8.60c	9.77cd
	40	6.33	2.33c	1.67	96.42	77.21ab	69.57ab	11.67abc	12.43ab	10.66bc
	80	3.67	2.33c	2.67	88.93	78.21ab	70.19ab	12.66a	12.53ab	9.33d
5-Sulpho - salicylic	100	3.66	2.33c	1.67	76.24	72.70ab	70.76ab	11.03abc	12.00ab	11.55ab
	200	3.00	2.33c	1.00	92.06	78.93ab	76.26a	11.53abc	11.76ab	12.11a
	300	3.67	2.33c	1.00	89.10	80.28a	69.65ab	11.73abc	12.30ab	10.33cd
L.S.D. at 0 .05		NS	2.05	NS	NS	12.05	9.50	1.56	1.74	1.18

*: Abo El Matameer.
L.S.D: Least significant differences at 0.05 level of probability.
NS: Not significant at 0.05 level of probability.
Means followed by the same letter are not significantly different according to L.S.D.at 0.05 level of probability.

Table 2. Effect of the concentrations of the used acids on means of non-opened florets/spike, florets diameter (cm.) and floret duration (day) of *Gladiolus grandiflorus* cv."White Prosperity" during the two seasons (2015 and2016)

Used acids	Concentrations (ppm)	Characteristics								
		Non-opened floret/spike			Floret diameter (cm.)			Florets duration (day)		
		Shatby 2015	Shatby 2016	Behira* 2016	Shatby 2015	Shatby 2016	Behira* 2016	Shatby 2015	Shatby 2016	Behira* 2016
Control	0	3.17ab	8.74a	6.04a	7.66e	9.68	8.81	3.00	2.33	2.33bc
Ascorbic	150	2.90abc	5.34b	3.73d	10.54cd	9.52	10.67	3.00	3.00	3.00abc
	200	2.14bcd	4.83bcd	5.22abc	10.19d	9.33	10.38	4.33	3.00	3.67ab
	250	2.11bcd	5.09bc	5.54abc	11.33bcd	8.54	10.03	2.67	2.00	3.67ab
Boric	30	1.12de	4.68bcde	5.83ab	11.83abcd	9.28	10.08	4.33	2.33	4.33a
	60	0.88de	3.36cdef	4.76bcd	13.46a	9.51	10.59	3.67	4.00	4.00ab
	120	0.66de	4.05bcde	4.37cd	8.37e	9.68	9.67	5.33	3.67	3.67ab
Glycine	20	3.73a	2.16f	5.30abc	11.04bcd	9.12	10.96	4.00	2.33	3.33ab
	40	0.43e	3.67bcdef	4.66bcd	10.33d	9.80	10.43	1.67	3.67	3.33ab
	80	1.58cde	3.50cdef	3.96d	11.68bcd	9.83	10.09	3.67	2.67	3.67ab
5-Sulpho - salicylic	100	3.44ab	4.51bcde	4.77bcd	12.33ab	10.15	10.22	3.00	4.33	2.33bc
	200	1.00de	3.14def	3.77d	12.25abc	9.71	10.75	4.33	4.00	1.33c
	300	1.43cde	3.02ef	4.50cd	11.11bcd	10.14	9.95	3.00	5.00	3.00abc
L.S.D. at 0. 05		1.54	1.79	1.23	1.77	NS	NS	NS	NS	1.69

*: Abo El Matameer.
L.S.D: Least significant differences at 0.05 level of probability.
NS: Not significant at 0.05 level of probability.
Means followed by the same letter are not significantly different according to L.S.D.at 0.05 level of probability.

Similar trend of results was reported by Gargi and Devi (2005) on *Gladiolus* and tuberose and Hajizadeh and Alilooo (2014) on tuberose plants.

Inflorescence duration (vase-life) (day):

Generally, data on means of the three experiments presented in Table 3 showed that all the used materials led to extend the inflorescence duration of gladiolus cut spikes, compared with control treatment. Also, ascorbic acid treatments gave the longest vase life period of gladiolus cut spike. Besides, adding ascorbic acid at 150 ppm to the holding solution gave the maximum period of inflorescence duration, compared with the control treatment (means of the three experiments). The previous treatment led to increase the inflorescence vase life with 15.88% over the control treatment.

These results were probably due to the role of ascorbic acid at a suitable concentration which serves as an important co-factor in the biosynthesis of many plant hormones, including ethylene, gibberellic acid and abscisic acid (Barth *et al*.2006). Besides, ascorbic acid contributes to the detoxification of reactive oxygen species (Conklin and Barth, 2004). This will have profound effects on the regulation of development process including flower senescence, consequently, the period of inflorescence duration could be increased.

Similar trend of results was found by Liao *et al*. (2012) on *Lilium* plants, Ahmad and Dole (2014) on *Zinnia* plants and Sellam *et al*. (2016) on sweet sultan flowers.

Florets dry weight (g):

Generally, data on means of the three experiments presented in Table 3 on floret dry weight per cut spike showed that glycine treatments gave the highest effect on the dry weight of the florets, compared with the other materials. Also, adding glycine at 40 ppm to the vase solution of gladiolus cut spike gave the heaviest florets dry weight, compared with the other treatments. The previous treatment led to increase the dry weight of the florets with 47.58% over the control treatment (as a mean of the three experiments).

These results may be related to the effect of glycine at a suitable concentration, which led to inhibit the photorespiration (Zeiger, 2010), stimulate the synthesis of the chlorophyll and activate the vegetative growth and photosynthesis process (Zaina *et al*.1995), consequently, the flower size could be increased and its dry weight would be too increased.

Similar trend of results was obtained by El-Mokadem (1991) on *Strelitzia reginae* and Gargi and Devi (2005) on *Gladiolus* and tuberose plants.

Total chlorophyll content (SPAD units):

Generally, data presented in Table 3 indicated that there were reductions (decomposition) in the values of the total chlorophyll content of the cut gladiolus spike leaves at the end of the experiment, compared with the mean of values of chlorophyll content in the leaves of cut spike at the beginning of the experiment which was 60.51 SPAD units. These reductions were probably due to the normal decompositions of the leaf pigments after cutting the spikes.

Besides, adding glycine at 20 ppm to the vase solution gave the minimum reduction of total chlorophyll content in the leaves of gladiolus cut spikes (as a mean of the three experiments), compared with the other treatments.

These results may be probably attributed to the direct role of glycine in the biosynthesis of the green pigments, which considers as a source for nitrogen and carbon as structural components of chlorophyll formation, hence using glycine at a proper concentration led to activate chlorophyll synthesis and protect its decomposition, consequently its content in the leaves of cut gladiolus spike could be maintained.

Similar trend of results was reported by Kazemi *et al*. (2012) on lisianthus and Kazemi and Ameri (2012) on carnation .

Total carbohydrates content (%):

Generally, data of means of the three experiments presented in Table 4 indicated that using boric acid at 30 ppm gave the highest value of the total carbohydrates content in the leaves of gladiolus cut spike, compared with the other treatments, which led to increase the leaf content of carbohydrate with 42.76% over the control treatment (as a mean of the three experiments).

These results may be probably due to the role of adding boric acid at a suitable concentration in delaying leaf senescence through a strongly inhibition of the climacteric ethylene production (Serrano *et al*.2001), besides it increases vase solution uptake (Al-Attrakchii and Mahdawe, 2015) and activates the photosynthesis process (Dale and Lukaszewski, 1998), consequently the assimilated materials could be increased and the percentage of total carbohydrates in the leaves of cut gladiolus spikes would be increased.

This finding was similar to those found by El-Mokadem (1991) on *Strelitzia reginae* and Hajizadeh and Aliloo (2014) on tuberose.

Table 3. Effect of the concentrations of the used acids on means of inflorescence duration (day), florets dray weight (g) and chlorophyll content (SPAD units) of *Gladiolus grandiflorus* cv."White Prosperity" during the two seasons (2015 an016)

Used acids	Concentrations (ppm)	Characteristics								
		Inflorescence duration (day)			Florets dray weight (g)			Chlorophyll content (SPAD units)		
		Shatby 2015	Shatby 2016	Behira* 2016	Shatby 2015	Shatby 2016	Behira* 2016	Shatby 2015	Shatby 2016	Behira* 2016
Control	0	21.44	20.44c	15.73	2.87g	3.98	4.93cd	16.82	7.04	11.13d
Ascorbic	150	24.22	25.00a	17.53	4.04fg	4.36	6.57a	18.28	9.67	26.57abc
	200	23.00	22.00bc	17.53	4.47efg	4.92	6.47ab	17.94	8.73	26.11bc
	250	23.67	22.44bc	17.73	4.94def	4.13	5.71abcd	26.39	7.74	30.84ab
Boric	30	23.77	21.11bc	17.10	6.49abcd	4.24	5.17cd	31.57	14.68	29.93ab
	60	24.33	22.66b	17.30	6.74abc	4.79	5.30bcd	32.60	7.65	18.84cd
	120	23.22	22.66b	17.53	6.16abcd	4.66	5.13cd	34.53	14.60	23.85bc
Glycine	20	25.11	20.88bc	17.30	7.67a	4.72	4.90cd	32.04	16.75	36.41a
	40	22.89	21.66bc	16.00	7.65a	4.29	5.47abcd	17.02	17.22	23.38bc
	80	22.55	21.33bc	17.63	6.78ab	4.23	4.53d	35.29	11.68	31.10ab
5-Sulpho - salicylic	100	22.53	22.11bc	17.67	5.03def	4.37	4.90cd	26.22	10.60	23.99bc
	200	22.66	21.77bc	17.07	5.11cdef	4.58	5.87abc	29.09	15.05	23.56bc
	300	23.77	22.88ab	16.83	5.94bcde	4.29	6.03abc	32.06	12.78	17.00cd
L.S.D. at 0.05		NS	2.13	NS	1.65	NS	1.22	NS	NS	9.97

*: Abo-El Matameer.
L.S.D: Least significant differences at 0.05 level of probability.
NS: Not significant at 0.05 level of probability.
Means followed by the same letter are not significantly different according to L.S.D.at 0.05 level of probability.

Table 4. Effect of the concentrations of the used acids on means of total carbohydrates (%), protein content (%) and amount of vase solution uptake (ml/day) of *Gladiolus grandiflorus* cv."White Prosperity" during the two seasons (2015 and 2016)

Used acids	Concentration (ppm)	Characteristics								
		Total carbohydrates (%) in the leaves			Protein content (%) in the leaves			Amount of vase solution uptake (ml/day)		
		Shatby 2015	Shatby 2016	Behira* 2016	Shatby 2015	Shatby 2016	Behira* 2016	Shatby 2015	Shatby 2016	Behira* 2016
Control	0	8.90d	9.44	9.44	8.92e	9.05 g	9.16 f	1.37c	1.20c	3.35
Ascorbic	150	9.93bcd	11.48	11.47	9.55de	11.00cde	10.65cde	1.78bc	1.54bc	4.44
	200	10.61abcd	10.95	10.72	11.08ab	10.84def	11.14abcd	1.56c	1.51c	3.89
	250	12.46ab	12.10	12.38	9.70de	11.59bc	11.10abcde	1.49c	1.42c	3.69
Boric	30	13.04a	13.51	13.12	10.67abc	11.53bcd	11.71a	2.41abc	1.37c	3.06
	60	10.12bcd	9.91	10.13	10.37bcd	11.46bcde	11.70a	1.98bc	2.01abc	3.23
	120	10.19bcd	13.61	10.18	10.41abcd	11.60bc	11.42ab	2.36abc	2.05abc	3.16
Glycine	20	10.93abcd	9.60	9.15	11.30a	12.33a	11.67a	3.45a	1.17c	2.95
	40	9.48cd	9.56	9.54	10.96ab	11.85ab	11.30abc	1.97bc	2.02abc	2.63
	80	10.62abcd	9.85	10.30	10.81ab	11.84ab	11.19abcd	3.08ab	1.78abc	3.11
5-Sulpho - salicylic	100	11.84abc	12.49	11.71	10.34bcd	11.19bcde	10.56de	2.32abc	2.42ab	3.75
	200	12.23abc	11.92	11.85	9.89cd	10.24f	10.82bcde	1.71c	2.54a	4.17
	300	12.54ab	12.12	12.45	10.62abc	10.82ef	10.41e	2.21abc	2.52a	3.59
L.S.D. at 0.05		2.78	NS	NS	0.92	0.71	0.69	1.33	0.89	NS

*: Abo El Matameer.

L.S.D: Least significant differences at 0.05 level of probability.

Protein content (%):

Generally, data of the three experiments presented in Table 4 indicated that almost all the used acids with their concentrations gave significant increases of the nitrogen content of gladioli cut spike leaves, compared with the control treatment. Besides, using glycine acid at 20 ppm gave the highest value of nitrogen content in the gladioli cut spike leaves, compared with the other treatments. The aforementioned treatment led to increase the nitrogen content in gladioli leaves with 30.20% over the control treatments (as a means of the three experiments).

These results were probably due to the role of glycine in plants, which it considered the building block of protein and chlorophyll and it serves as parts of co-enzymes or as precursor of certain plant hormones and improves photosynthesis (Amin *et al*.2011), consequently the nitrogen content in the leaves of the cut gladiolus spike could be increased.

Similar trend of results was found by Kazemi and Ameri (2012) on carnation and Abri *et al*. (2013) on rose.

Amount of the absorbed vase-solution(ml/day/spike):

Generally, data on the means of the three experiments presented in Table 4 indicated that all the used materials gave increases in the amount of the absorbed vase solution by the cut gladiolus spikes, compared with the control treatment. Besides, adding 5-sulfosalicylic acid with any concentration to the vase solution led to increase the amount of the absorbed vase solution, compared with the other treatments. Also, adding 5-sulfosalicylic acid at 100 ppm to the vase solution gave the maximum amount of the absorbed vase solution, compared with the other treatments. The previous treatment led to increase the amount of the absorbed vase solution with 43.65% over the control treatment (as a mean of the three experiments, Table 4).

These results may be probably due to the role of 5-sulfosalicylic acid at a proper concentration in plants. 5-sulfosalicylic acid protects chlorophyll (Peng *et al*.2007), and protein degradation (Soobedar *et al*.2015), delays the senescence of the tepals of cut gladiolus flowers (Hatamzadeh *et al*.2012), enhances the relative water content of leaves (Hassan and Ali, 2014), prolongs membrane stability. All these factors probably led to increase the efficiency of the cut gladiolus spikes to absorb a large amount of the vase solution.

Similar trend of results was reported by Dantuluri *et al*. (2008) on *Gladiolus*, Sardoei *et al*. (2013) on *Narcissus* and Puneet and Mukherjee (2015) on pot marigold.

Colony number per Petri dish:

Generally, results of the isolation of the microorganisms from the vase solution on potato dextrose medium showed that there were only two distinct groups of microorganisms i.e. *Penicillium sp*. and yeasts.

With respect to the data of the three experiments presented in Table 5 it is clear that using boric acid gave the lowest colonies number of the two isolated microorganisms, compared with the other treatments.

Besides, adding boric acid at 120 ppm led to a large inhibition of the microbial growth in the vase solution, compared with the other treatments. The previous treatment led to decrease the colonies number of the two isolated microorganisms with 95.46 %, compared to the control treatments, (as a mean of the three experiments).

These results were probably due to the role of boric acid at a suitable concentration in inhibition of the microbial growth of *Penicillium sp*. and yeasts as reported by Davood *et al*. (2014).

Similar trend of results was reported by El-Mokadem (1991) on cut bird of paradise flowers, Hajizadeh and Aliloo (2014) on tuberose, Al-Attrakchii and Mahdawe (2015) on carnation and Azizi *et al*. (2015) on lisianthus.

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الملخص العربي

تـــأثير بعض المواد الكيماوية على مدة حياة أزهار الجلاديولاس المقطوفة

محمود خطاب، محمد التركى، عبد الحميد طرابية، هند راشد

أجرى هذا البحث تحت الظروف المعملية بقسم الزهور ونباتات الزينة وتنسيق الحدائق بكلية الزراعـــة بالـــشاطبى بجامعة الإسكندرية وفى مركز أبـــو المطـــامير بمحافظـــة البحيرة خلال عامى ٢٠١٥ و٢٠١٦ بهدف إمكانيـــة تفـــتح زهيرات نورات الجلاديولس المقطوفة فى مرحلة ظهـــور اللون فى الزهيـــرات القاعديـــة للنـــورة صـــنف "وايـــت بروسبرتى" وتأثير ذلك على جودة النورات ومدة بقائها فى الفازة وبعـــض التحلـــيلات الكيماويـــة لـــلاوراق وعـــدد مستعمرات الكائنات الدقيقة فى ماء الفازة بإستخدام ثلاثـــة تركيزات من كل من حـــامض الأســـكوربيك (١٥٠ و٢٠٠ و٢٥٠ جزء فى المليون) وحامض البوريك (٣٠ و٦٠ و٩٠ جزء فى المليون) وحامض الجليسين (٢٠ و٤٠ و٨٠ جزء فى المليـــون) وحـــامض ٥-سالفوسالـــسيلك (١٠٠ و٢٠٠ و٣٠٠ جزء فى المليون).

وقد أظهرت النتائج أن جميع الآحماض المستخدمة لهـــا تأثير موجب على جودة أزهار الجلاديولس المقطوفة. وأن إضافة حامض البوريك بتركيز يتراوح من ٣٠ إلـــى ١٢٠ جزء فى المليون يزيد من قطر الزهيرات ويطيل عمرهـــا ويثبط من نمو الكائنات الدقيقة فى محلول الفازة. كمـــا أن إستخدام حامض ٥-سالفوسالسيلك بتركيز يتراوح من ١٠٠ إلى ٢٠٠ جزء فى المليون يؤدى إلى تفتح سريع لزهيرات النورة ويزيد من عدد الزهيرات المتفتحة ويقلل مـــن عـــدد الزهيرات غير المتفتحة لكل نورة ويزيد مـــن كميـــة مـــاء الفازة الممتص.