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Effects of Post Harvesting On Biochemical Changes in *Gladiolus* Cut Flowers Cultivars [*White prosperity*]

[1]Sakine Faraji, [2]Roohangiz Naderi, [1]Orudj Veli Ibadli,
[3]Tayebe Basaki, [1] Shakir Nebi Gasimov and [4]Sona Hosseinova

[1]Institute Central Botanical Garden, Azerbaijan National Academy of Sciences, Baku, Azerbaijan
[2]Department of Horticultural Sciences, Tehran University,
College of Agriculture and Natural Resources, Karaj, Iran
[3]Agricultural and Natural Resources Research Center of Markazi Province, Arak, Iran
[4]Seed and Plant Improvement Institute (SPII), Mahdasht Road, Karaj, Iran

Abstract: Cytokine and gibberellic acid have been reported in several studies to improve the postharvest vase life of many cut flowers. Foliar application of nutrients and plant growth regulators may improve flower quality parameters. In this study the postharvest behavior of *Gladiolus* was studied on White Prosperity cultivars to increase longevity of cut flowers. Primarily bulbs were treated with four different concentrations of benzyladenine (0, 100, 150, 200 mg/l) and gibberellic acid (GA_3) (0, 50, 100, 150mg/l) solely for 6 hours then planted. After 1, 5 and 10 days after harvest. Evaluations of carbohydrate, protein and chlorophyll content in the leaf and petals were done. The results showed that the soluble sugar content increased in both of the petals and leaves in 5th day after harvest. Soluble sugars content in leaves were higher than the petals in 5th day after harvest but this ratio was reversed 10 days after harvest. It was found that treatment with benzyladenine by 200 mg/l and gibberellic acid by 100 mg/l had high sugar content in the petals and leaves respectively also high concentration of protein content was detected in the petal in 1 and 5 days and in the leaves in 10 days after harvesting. It was found that provision of 200 mg/l benzyladenine increased protein level in petals and gibberellins acid by 100 mg/l increase protein content in the leaves effectively. It seems that, benzyladenine delay senescence by retarding the rate of breakdown of protein synthesis. According to the our results gibberellins acid and benzyladenine by increase soluble sugar and retarding degradation protein and chlorophyll increase longevity of cut flowers.

Key words: vase life · Benzyl adenine · Gibberellins

INTRODUCTION

Commercial floriculture is one of the most profitable agro industries in the world [1]. Decrease of cut flowers quality at harvesting time to market is a great problem for growers. Plant growth regulators have an important role in increasing horticulture production [2]. Vase life and membrane stability of cut spike of Gladiolus have been increased by using benzyladenin and gibberellic acid [3]. Flowers are extremely perishable making their physiological functions vary actively even after harvest. Carbohydrates are important reserve compounds. Especially Sucrose is the most abundant soluble carbohydrate and delay petal senescence. The senescence of cut flowers is closely related to a considerable reduction of the energy needed for synthesis reactions [4]. For flower opening, large amount of soluble carbohydrate is required as the substrate for respiration and synthetic materials as well as osmolytes [4, 5]. Several environmental stresses can potentially disrupt comparementation in petal cells. These include water stress and shortage of carbohydrates. Vase solution treatment of GA_3 (50 mg l^{-1}), followed by BA (50 mg l^{-1}) with sucrose (50 g l^{-1}) significantly increased solution uptake, fresh weight and dry weight of cut spikes [3]. Treatment of spring *Gladiolus* bulb with 50 mg/l BA either alone or in combination with 50 mg/l GA_4 delayed the flower senescence. in addition to cytokine and gibberellic

Corresponding Author: Sakine Faraji, Institute Central Botanical Garden,
Azerbaijan National Academy of Sciences, Baku, Azerbaijan.

acid have been reported in several studies to improve the postharvest vase life of many of cut flowers. Foliar application of nutrients and plant growth regulators may improve flower quality parameters. It has been found that spraying blue magic iris with 50 mg/l BA either alone or with 50 mg/l GA_2 delayed the onset of flower [6]. Cytokinins increased chlorophyll development and chlorophyll syntheses [2]. Chlorophyll degradation in leaves of cut flowers is controlled by gibberellins prevents leaves senescence and delay proteolysis and chlorophyll degradation have been known to prevent leaf senescence by arresting degradation of protein and chlorophyll [7]. In this study, we investigated changes in carbohydrate, protein and chlorophyll in cut flower by application gibberellin (GA_3) and benzyladenine (BA) of bulbs in order to increase longevity of cut flowers Gladioluse Cultivars [*White Prosperity*].

MATERIALS AND METHODS

Plant Materials: Experiments were carried out in 2009-2010 in the Agricultural and natural resources center of Markazi province in Iran. Bulbs were placed in plastic vases containing BA in concentrations of 0, 100, 150 and 200 mg/l and GA_3 in concentrations of 0, 50, 100 and 150 mg/l. The vases containing various concentrations of BA and GA_3 were arranged in a completely randomized design (CRD) with 3 replications. Bulbs were grown under commercial conditions in field. Flower spikes appear in the stage 7 leaves stem. Specified stems were harvested when the first flower bud showed full color. Cut stems were transported to the laboratory. The cut flowers were immediately put into 300 cc glasses containing water. During the experiment light intensity was full natural light, temperature was 20±2 and relative humidity was 60% until end vase life.

Dependent Variables Determination: The vase life of *Gladiolus* cut flowers was determined by changes in carbohydrate content in leaves and petals and also leaves chlorophyll content. Soluble carbohydrates were extracted from leaves and petals (on Days 1, 5 and 10). 0.25 g chopped material of perianth tissue was fixed in the ethanol. Then the material was macerated and centrifuged (3500 X, 10 min). Finally, the supernatants were pooled and used for the estimation of carbohydrate content. Carbohydrates were measured by the method of Pakqain and Lechacer [8]. Using antron as the standard solution. Proteins were extracted from leaves (on Days 1, 5 and 10) and petals through an extraction buffer (0.01 M tris-HCL) and protein assay was carried out according to method of Bradford [9]. To measure the leaves chlorophyll content, at each stage 0.5 gr chopped material of perianth tissue was fixed in deionized water. The tissue was homogenized in 10 ml acetone. Then the material was macerated and centrifuged (3500 X, 10 min) and the supernatants were pooled and used for the estimation of chlorophyll content. According to Ausati absorbance of extracts was measured using a WAPS 105 spectrophotometer. The leaf chlorophyll content was determined as absorbance of these extracts at 663 and 645 nm [10].

Statistical Analysis: Data were analyzed using one-way ANOVA with the generalized liner model procedure of SAS (Version 9.1, SAS institute Inc., Cary, NC, USA), Significant ($P \leq 0.01$) treatment effects were determined by ANOVA and data means were separated by the LSD test at P=0.01 [11].

RESULTS

Total Sugar Content: There were significant differences ($p \leq 01$) in soluble sugar content among treatments. The highest sugar content in both of the petals and leaves were observed after 5 days (Table 1).A significant effect ($p \leq 0/01$) obtained on flowers treated with BA and GA_3. gibberellic acid dose by 150 mg/l and benzyladenine by 200 mg/l had high sugar content in petals and leaves

Table 1: Effect of pretreatment bulbs with GA_3 and BA on soluble sugars content of petals and leaves of Gladiolus at 1,5,10 vase life

Vase		GA(mg/l)				BA(mg/l)			
life(day)	Organ	0	50	100	150	0	100	150	200
1	P(mg/g)	212^{e}	220^{c}	268^{b}	324^{a}	212^{e}	109.9^{g}	219.2^{d}	186.6^{f}
1	L(mg/g)	370.74^{c}	302^{e}	278.6^{f}	368.4^{d}	370.7^{c}	209.3^{g}	418.6^{a}	417.6^{b}
5	P(mg/g)	304.6^{d}	354^{a}	338^{b}	284^{e}	304.6^{d}	162.4^{g}	314.4^{c}	279.2^{f}
5	L(mg/g)	368.58^{f}	343.6^{g}	398^{c}	386.4^{d}	368.5^{e}	251.9^{h}	503.8^{a}	503.8^{b}
10	P(mg/g)	200^{e}	312^{b}	322^{a}	284^{c}	200^{e}	142.9^{f}	312.4^{b}	259.2^{d}
10	L(mg/g)	170^{f}	170.02^{e}	177^{d}	181.8^{c}	170^{f}	97.6^{g}	195.72^{a}	194.8^{b}

Values with different superscripts along columns are significantly different (p_0.01)

Table 2: Effect of pre treatment with GA_3 and BA on soluble protein content of petals and leaves of Gladiolus at 1,5,10 vase life

Vase		GA(mg/l)				BA(mg/l)			
life(day)	Organ	0	50	100	150	0	100	150	200
1	P(mg/g)	10.2^{g}	12.8^{b}	12.2^{c}	10.9^{f}	10.2^{g}	11.6^{d}	11.4^{e}	15.58^{a}
1	L(mg/g)	4.34^{f}	6.4^{d}	7.4^{b}	7^{c}	4.34^{f}	5.8^{e}	5.8^{e}	8.94^{a}
5	P(mg/g)	9.24^{d}	12.8^{b}	13.6^{a}	8.34^{g}	9.24^{d}	8.6^{f}	9.2^{e}	12.1^{c}
5	L(mg/g)	9.68^{c}	6.14^{f}	11.8^{a}	11.4^{b}	9.68^{c}	7.4^{e}	6^{g}	9^{d}
10	P(mg/g)	7.38^{d}	7f	7.2^{e}	5.4^{g}	7.38^{d}	9.8^{b}	8.94^{c}	13.6^{a}
10	L(mg/g)	9.68^{c}	11.8^{b}	11.8^{b}	12^{a}	9.68^{c}	9.6^{d}	7.4^{e}	9.4^{f}

Values with different superscripts along columns are significantly different (p_0.01)

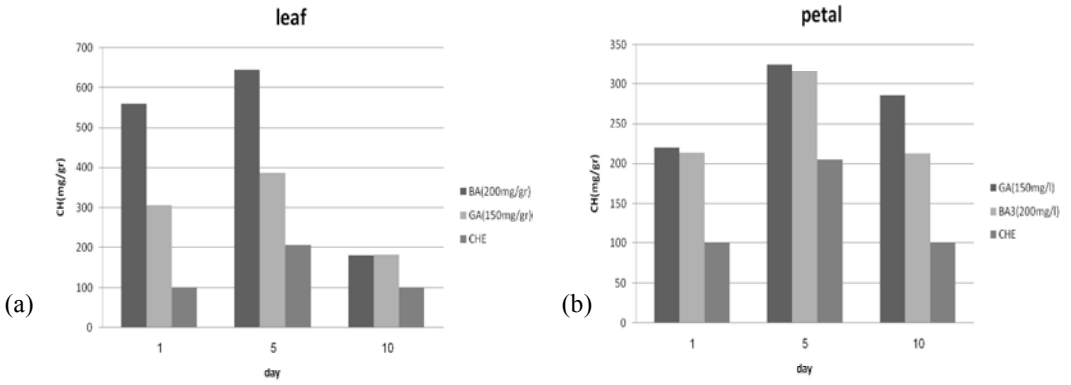

Fig. 1: Effects of various GA and BA per tertment bulbs on the change soluble carbohydrat of the upper most petal and leaf during vase life in gladiolus(a,b)

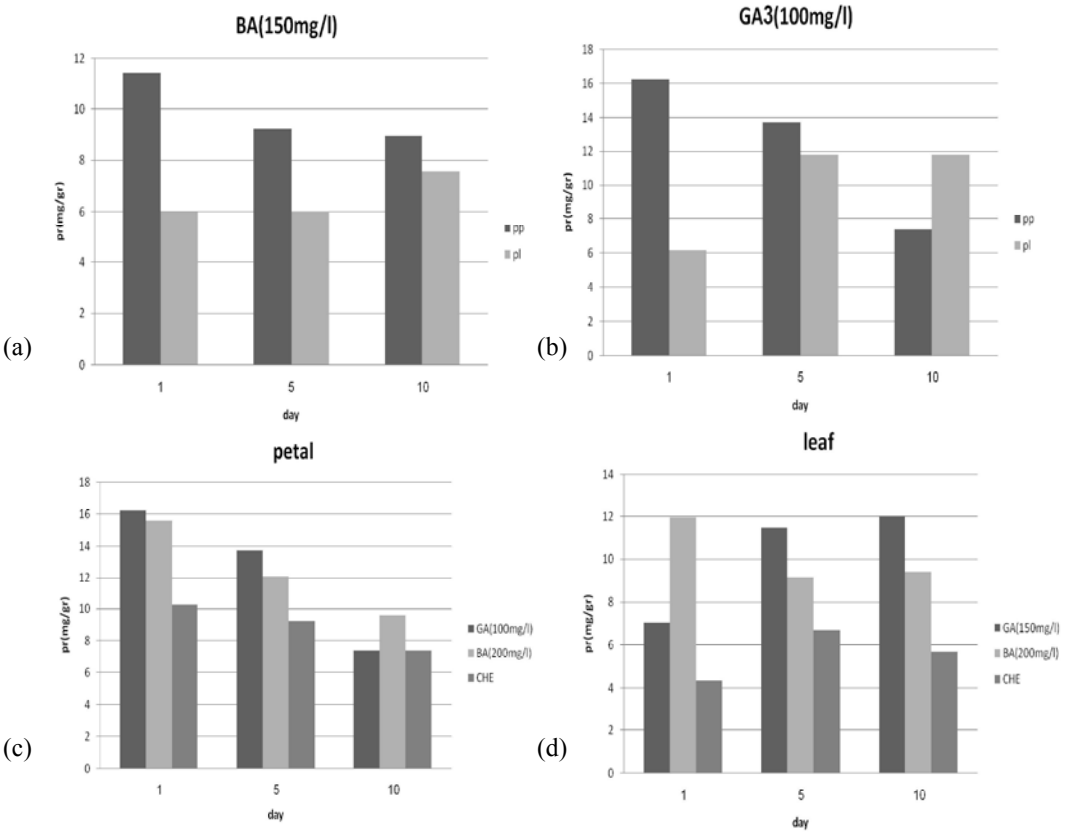

Fig. 2: Effect of various BA and GA per tertment bulbs on change soluble protein of the uppermos leaf and petals during vase life in Gladiolus

Table 3: Effect of pre treatment with GA3 and BA on total chlorophyll content leaves of Gladiolus at 1,5,10 vase life

		GA(mg/l)				BA(mg/l)			
Vase life(day)	Organ(mg/gr)	0	50	100	150	0	100	150	200
1	Leaf	0.24^{g}	0.316^{c}	0.37^{b}	0.392^{a}	0.24^{g}	0.252^{f}	0.285^{e}	0.29^{d}
5	Leaf	0.28^{g}	0.415^{d}	0.5^{a}	0.457^{b}	0.28^{g}	0.282^{f}	0.364^{e}	0.432^{c}
10	Leaf	0.193^{f}	0.217^{e}	0.24^{c}	0.328^{b}	0.193^{f}	0.223^{d}	0.207^{f}	0.381^{a}

Values with different superscripts along columns are significantly different (p_0.01)

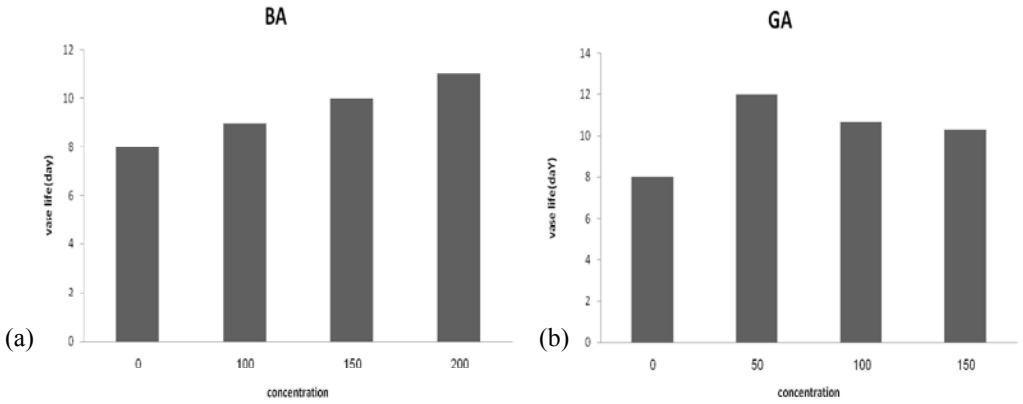

Fig. 3: Effect of GA_3 and BA on vase life of cut flower Gladiolus

respectively (Fig.1). In all treatments the highest amount of carbohydrate concentration in the leaves was demonstrated one day after harvesting while the highest amount in the petals was ten days after harvesting (Table1). Although, every one of BA and GA_3 concentration treatments demonstrated the highest carbohydrate content in both of the petals and leaves increase after five days after harvest. Finally, on 10^{th} day, carbohydrate concentration began to decline exhausting the substrates.

Total Protein Content: On the 5^{th} day GA_3 concentration by 100 mg/l significantly raised protein content in the leaves and petals in comparison with other studied GA_3 (Table 2). Also it was found that provision of 200 mg/l BA increased protein level in the petals in comparison with other BA treatments. Protein content in the petals was higher than the leaves in 1 and 5 days after harvesting while petals had lower protein concentration than the leaves in 10 days after harvesting. Also in the presence of BA, protein content in the petals was higher than the leaves on the 10^{th} (Fig 2b). These trials showed that GA_3 increase protein content in the leaf effectively also BA significantly raised protein content in the petal ten day after harvesting. (Fig 2 c, d).

Leaf Chlorophyll Content: In this study, BA and GA_3 application affected the chlorophyll content. Treatment with 200 mg/l BA and 150 mg/l GA_3 was the most effective one in retarding chlorophyll degradation as evidenced by the retention of high leaf chlorophyll content (Table 3).But the color change in leaves was not observed.

Vase Life: BA and GA_3 treatments increase vaselife of cut flowers effectivly. Control plant exhibited a mean of only 8 day whereas the BA treated with 200mg/l dose had 11 day (Fig 3b). GA_3 treatments by concentration 50 and $100 mgl^{-1}$ significantly increased the longevity of cut flower in comparison with control (GA 0mg/l) (Fig 3a).

DISCUSSION

Gibberellic acid affect on α-amylase synthesis significantly, therefore total soluble carbohydrate content increased and this could contribute to improve the energy pool (or resource) and/or increase the osmotic potential of flowers [12] this study showed that GA dose by 100 mg/l and BA by 200 mg/l increase the amount of sugar content in petals and leaves, respectively.

It was found that increase in carbohydrate content in the leaves caused increase in cut flowers longevity. Carbohydrate concentration was the highest amount in the leaves in the first day after harvest while the highest amount in the petals was 10 days after harvesting (Table1). This indicated that carbohydrate can be transmitted in the petals. Total carbohydrate content in the petals and leaves varied during the evaluation period. Reduction in carbohydrate content after first day can be

of the increase in the respiration rate [12]. Both of the BA and GA_3 concentrations, the carbohydrate content showed a rise after 5 days due to the reduction in the respiration rate. Finally, on 10th days after harvesting, carbohydrate concentration began to decline exhausting the substrates. These results agree with Figueroa and Colinas [14]. Gibberellic acid may block the synthesis of enzymes involved in starch hydrolysis as it has been seen in carnations [15]. Vase solution treatment of GA_3 (50 mg l^{-1}), followed by BA (50 mg l^{-1}) with sucrose (50 g l^{-1}) significantly increased the concentration of reducing and non-reducing sugars in gladiolus petals 4 days after treatment (DAT). Benzyladenine delay senescence by protecting cells and proteins. Benzyladenine can increase sugars availability in cell by increasing in ?- amylase and invertase enzyme activity [16]. Protein content in the petals was higher than the leaves 1 and 5 days after harvest while petals had lower protein concentration than the leaves 10 days after harvest. Also in the BA protein content in the petals was higher than the leaves on the 10th day after harvest. Benzyladenine increase vase life in the cut flower by delay breakdown degradation protein [7]. These trials showed GA_3 most effective increase protein content in the leaf also BA significantly raised protein content in the petal; this could be protein transport towards the flowers. Gibberellic acid and benzyladenin prevent of Chlorophyll degradation in leaves of cut flowers [16]. Results with application of cytokinins which delay senescence of various flowers support the possibility that the diminishing of internal concentrations of phytohormones may be associated with senescence processes in cut flowers [17]. In this study GA3 treatments significantly increased the longevity of cut flower in comparison with control (GA 0 mg/lit). The main effect of applied GA3 in extending cut flower vase life was to maintain mitochondrial structure and functions. GA_3 delay the senescence of flower and reduced the effect of ethylene in promoting. There is a possibility of GA_3 by either quality the sensitivity of the tissue ethylene or by delaying the natural rise in ethylene production [18].

CONCLUSION

The results of our study indicate that GA and BA by concentration 100 and 200 mg/l increase the vase life of *Gladiolus* cut flower by number of days to half opening of primary florets days to 50% petal fall and delayed the onset of 50% leaf yellowing. Also GA and BA improved *Gladiolus* cut flower quality by increasing the carbohydrate and protein content in the leaf and petals hence delaying the onset senescence Therefore, GA and BA at 100 and 200, respectability Has the potential to be used as a commercial cut flower preservative for prolong the vase life and post harvest quality of *Gladiolus* cut flowers.

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