

## EFFECT OF GROWTH REGULATORS AND PRESERVATIVE SOLUTION ON VASE LIFE AND WATER RELATION OF *Gladiolus hybrida* L. AFTER CUT FLOWERS

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### ABSTRACT

This experiment was conducted to study the effect of five concentrations of growth regulator of (0, 25 GA3, 50 GA3, 100 Salicylic acid, 150 Salicylic acid) mg.L<sup>-1</sup> and three types of preservative solutions on the vase life and water relations for *Gladiolus hybrida* L. after cut flower. The experiment was conducted as a factorial experiment (3×5) according to Randomized Complete Blocks Design, with three replicates. The results showed that GA3 (50 mg.L<sup>-1</sup>) significantly excelled in relative fresh weight of 155.33%, absorbed water 59.00 g /flower /day, the lost water 32.99 g /flower /day, water balance 26.01 g /flower /day, vase life 16.96 days, dry weight of flowers 22.89 g, and carbohydrate content in petals 22.34 %, and total carotenoids content in petals 7.84 mg/100 g dry weight. The second solution (5% sucrose + 200 mg.L<sup>-1</sup> 8.HQS + 200 mg.L<sup>-1</sup> citric acid) is significantly excelled in most studied traits. The interaction treatment that consisted of (50 mg.L<sup>-1</sup> + second solution) is significantly excelled in traits of the relative fresh weight 168.47%, absorbed water 66.32 g/flower /day, the lost water 23.39 g/flower /day, water balance 42.93 g/flower /day, vase life 21.25 days, dry weight of flower 26.11 g, carbohydrate content in petals 20.78% and total carotenoids content in petals 10.06 mg/100g dry weight.

Keywords: Vase Life, Gibberellic acid, Salicylic acid, water balance, absorbed water

\* Part of Ph.D dissertation of the 1<sup>st</sup> author

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تأثير منظمات النمو ومحاليل الحفظ في العمر المزهري والعلاقات المائية لأزهار الكلايولس *Gladiolus hybrida* L. بعد القطف.

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باحث

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المستخلص

نفذت التجربة لدراسة تأثير خمس تراكيز من منظمات النمو (صفر، 25 جبرلين، 50 جبرلين، 100 السالسليك، 150 سالسليك) ملغم.لتر<sup>-1</sup> وثلاث انواع من محاليل الحفظ وتأثيرهما في العمر المزهري والعلاقات المائية لأزهار الكلايولس *Gladiolus hybrida* L. بعد القطف، نفذت تجربة عاملية (3×5) وفق تصميم القطاعات الكاملة المعشاة بواقع ثلاثة مكررات. اظهرت النتائج تفوق معاملة 50 ملغم.لتر<sup>-1</sup> حامض الجبرلين معنويا في صفات الوزن الطري النسبي 155.33%، الماء الممتص 59.00 غم /زهرة/يوم، الماء المفقود 32.99 غم /زهرة/ يوم، التوازن المائي 26.01 غم /زهرة/يوم، العمر المزهري 16.96 يوم، الوزن الجاف للزهرة 22.89 غم، محتوى الكاربوهيدرات في البتلات 22.34%، صبغه الكاروتينيدات الكلية في بتلات ازهار الكلايولس 7.84 ملغم/100غم وزن جاف. بينما تفوق المحلول الثاني (5% سكروز + 200 ملغم.لتر<sup>-1</sup> حامض الستريك 200 + ملغم.لتر<sup>-1</sup> 8-HQS) معنويا في معظم الصفات المدروسة. كما تفوقت معاملة التداخل بين (50 ملغم.لتر<sup>-1</sup> حامض الجبرلين + المحلول الثاني) معنويا في صفات الوزن الطري النسبي 168.47%، الماء الممتص 66.32 غم /زهرة/يوم، الماء المفقود 23.39 غم /زهرة/يوم، التوازن المائي 42.93 غم /زهرة/ يوم، العمر المزهري 21.25 يوم، الوزن الجاف للزهرة 26.11 غم، صبغه الكاروتينيدات الكلية 10.06 ملغم/100غم وزن جاف.

الكلمات المفتاحية:- العمر المزهري، حامض الجبرلين، حامض السالسليك، التوازن المائي، الماء الممتص

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## INTRODUCTION

*Gladiolus hybrida* L. is one of the most important economic flowers of the Iridaceae family and comprises about 92 genus and more than 260-300 species that are naturally spread in the Central and South Africa region, especially in Asia and Southern Europe, which are monocotyledons, Gladiolus bulbs are an annual summer under Iraq's climatic conditions and can be grown with autumn and spring season, it also can be produced throughout the year and cultivated under protected environment conditions, the importance of Gladiolus is a very good cut flowers, it is characterized by a short period of growth, which takes between 75-120 days, as well as multiple flower colors and long-vase life, and for the flowers of some of its cultivars aromatic smell (18,25). Gladiolus is an important commercial crop and occupies a distinct position as a cut flowers both in local use and in world export, it is classified as one of the top 10 commercial flowers in the world, it is ranked first in terms of quantity of production and economic importance for their possibility of cultivation and production throughout the year. Netherlands, America and Australia are one of the most important countries producing Gladiolus flowers in the world (14,22). The life of Gladiolus flowers after cut Flowers is affected by the evolutionary stage for flower either when flower cutting or when treatment it by some chemicals materials, including the growth regulators (Salicylic and Gibberellic acid) which delay the senescence of flowers, and inhibition of ethylene action which causes rapid downfall of the petals, growth regulators also limit the activity of the analyst enzymes for flowers cells, which enables it to delay the appearance of signs of the expiration vase life such as wrap, shrinkage of the petals and reduce the transpiration rates of petals. As the components of preservative solutions also work, especially sucrose, which is the main source of energy needed to continue the life of flowers after the cutting, and citric acid, which controls pH of the solution, which facilitates the absorption of substance solution easily as well as the role of substance (8-Hydroxyquinoline-sulfonic acid (8HQS)), which positively affect in the life of the

flowers after the cutting and act as a sterile material that prevents the growth of microorganisms and bacteria and prevent the closure of vessels stem and prevent the transport of water to flower, these materials work together on prolong vase life for Gladiolus (3, 17). This research aims to determine the best concentration of Salicylic acid and Gibberellin, the best preservative solution to extend the vase life of Gladiolus flowers, and study the interaction between the types of preservative solutions and the growth regulators and their effect on the water relations.

## MATERIALS AND METHODS

**Implementation of the experiment:** This experimental was conducted at Al Mussaib Technical College in Babylon province at the Spring season 2017. Gladiolus corms were cultivated, Amsterdam cultivar, that is produced by Dutch company (Stoop flower) with a diameter of  $(5 \pm 2\text{cm})$  at 25/2/2017, to study the effect of the addition of growth regulators (Salicylic, GA3) and preservation solutions after cut Flowers with water relations and the vase life for Gladiolus flowers, The corms were cultivated in a 27 cm diameter plastic flowerpot filled with an agricultural media consisting of [loamy sand + (1/2 Peat moss + 1/2 plant residues)] with the ratio of (3:1), all service operations such as irrigation, fertilization and control were conducted as needed to obtain flowers of good quality and suitable for cut flowers. Inflorescences of the Gladiolus were cut early in the morning and when the color appearance in the first basal flowers, 1 cm of the bases of inflorescence was cut into vessels which contained water. The height of the inflorescences were unified to 60 cm length, then transferred flowers to a room at a temperature  $(30 \pm 2)$ , with 16 hours lighting rate, inflorescences were placed in plastic flowerpot which contained 500 ml of preservation solution. The preservation solutions were not change during the experiment as shown in ( Figure 1).

### Factors and levels of experiment

#### a- First factor: Growth regulators

Two types of growth regulators were used: Salicylic acid and Gibberellin acid due to the difficulty of melting Salicylic in water, the

Gibberellin acid was used as a powder 90%. The growth regulators added as preservation solutions to a prolong vase life were at the following concentrations: (0, 25 GA<sub>3</sub>, 50 GA<sub>3</sub>, 100 salicylic acid, 150 salicylic acid) mg.L<sup>-1</sup>

**b- Second factor: Preservative solutions:** Preservative solutions consisted of sucrose were adopted as a source of energy needed for the growth of flowers and 8-Hydroxyquinoline sulfate (8-HQS), it's an important sterile material that limits the growth of microorganisms, pure citric acid was added at a concentration of 98% to make the media is acidic, and the solutions were prepared according to the following concentrations:

**a- Distilled water**

**b- First solution** (2.5% sucrose + 100 mg.L<sup>-1</sup> 8.HQS + 100 mg.L<sup>-1</sup> citric acid)

**c- Second solution** (5% sucrose + 200 mg / l 8.HQS + 200 mg / L citric acid)

**Experimental design**

The experiment was carried out as a factorial experiment (3× 5) according to Randomized Complete Blocks Design, with three replicates, each one of them containing 15 treatments with four flowers per experimental unit, and the means were compared to according to least significant differences (L.S.D) under 5% probability level (2) Data were analyzed using the ready statistical program (Genstat).

**Studied traits**

**a- Relative fresh weight of cut flowers (RFW)(%)**

The weight of the flowers was measured after the cut Flowers and before they were placed in the preservation solutions by a sensitive balance, then were measured every two days until the loss of flowers value, The relatively fresh weight and according to the equation (10):

$$\text{RFW (\%)} = \frac{\text{fresh weight at the day is 0,2,4 ... etc}}{\text{Weight at 0day}} \times 100$$

Day(0): is the first day of starting the experiment.

**b- Absorbed water (g /flower /day):**

The absorbed water was calculated by measuring the weight of the preservation solution on the day 0, measuring its weight every two days until the loss of flowers its coordination value and according to equation (10):

**Absorbed water** = the weight of the solution at the start of the experiment - the weight of the solution in the day 0, 2,4, ... etc.

**c- The lost water (g /flower /day):**

The lost water was measured by weighing the cut flowers with their solutions on the first day and then measuring their weight together, then re-weighting every two days until the loss of flowers value according to the equation (10):

**The lost water** = the weight of flowers with their solutions at the start of the experiment - the weight of flowers with their solutions in the day 0,2,4, ... etc.

**d- Water balance (g /flower /day):**

Water balance was calculated according to the equation (10):

Water balance = Absorbed water - The lost water

**e- Dry weight of cut flowers (g):**

The flowers were dried with their flowering stems by placing them in perforated bags and then placed in an electric oven at 70°C until the weight was stable and weighed with a sensitive balance.

**f- The percentage of carbohydrates in petals (%):**

Total carbohydrate content in petals was estimated according to the method mentioned by (13).

**a-Estimate Total Carotenoids pigment in the petals (mg/100g dry weight):** Total Carotenoids content was estimated for Gladiolus flowers according to Ranganna method mentioned (21) by using Spectrophotometer device and with a wavelength of 452 nm

**a-Vase life (day):** It was calculated by the number of days from cutting the flower and placing them in preservation solutions until the loss of flowers value (24).





Figure 1. Shows the stages of flowers growth and their vase life

## RESULTS AND DISCUSSION

**First: Effect of the growth regulators and the preservative solutions and the interaction between them in traits of the relative fresh weight, absorbed water, lost water and the water balance of Gladiolus cut flowers:** Table 1 shows growth regulators have a significantly role in influencing life after cut flower. The results showed that treatment of GA3 (50 mg.L<sup>-1</sup>) was

significantly excelled than other treatments in the traits of relative fresh weight, water absorbed, lost water, and water balance, as it reached 155.33%, (59.00, 32.99, 26.01) g /flower /day respectively, followed by Salicylic acid treatment of (150 mg.L<sup>-1</sup>), which gave the second highest values for the relatively fresh weight, water absorbed, lost water, and water balance, as it reached 149.47%, (55.33, 36.91, 18.41) g /flower

stem/day respectively, while the control treatment gave the lowest rate of the mentioned traits reached (128.55 %, 43.53, 44.94, -1.41 g /flower /day) respectively. It is noted from the results of the same table that preservative solutions are of great importance in maintaining the quality of flowers. The treatment of the second solution was significantly excelled in most of the studied traits by giving it the highest of relative fresh weight, water absorbed, lost water, and water balance, as it reached 154.82%, (57.78, 31.85, 25.92) g /flower /day, respectively, while the control treatment (distilled water) gave the lowest values of the traits: relative fresh weight, water absorbed, lost water, and water balance, as it reached 128.91%, (45.33, 48.02, -2.69) g /flower /day, respectively. The

interactions between growth regulators and preservative solutions indicated significant differences in the increase of studied traits (table 1). The interaction which consisting of (50 mg.L<sup>-1</sup> GA3 + second solution) was significantly excelled on other interaction treatments in traits of the relative fresh weight of 168.47%, Absorbed water of 66.32 g /flower /day, the lost water of 23.39 g /flower /day, water balance of 42.93 g /flower /day, all interaction treatments significantly excelled on the control treatment (without addition) which gave the lowest values to the traits of relative fresh weight of 116.57%, absorbed water of 36.98 g /flower /day, the lost water of 55.14 g /flower /day, water balance of -18.16g /flower /day.

**Table 1. Effect of growth regulators and preservative solutions and the interaction between them in relative fresh weight, absorbed water, water lost, and water balance of Gladiolus flowers**

Growth regulators (mg.L <sup>-1</sup> ) (A)	Preservative solutions (B)	Relative fresh weight (%)	Absorbed water (g/flower /day)	The lost water (g/flower /day)	water balance (g/flower /day)
Without adding	Distilled water	116.57	36.98	55.14	-18.16
	First solution	133.83	45.20	40.11	5.09
	Second solution	135.24	48.42	39.56	8.85
100 Salicylic	Distilled water	126.14	42.36	50.28	-7.92
	First solution	149.22	50.63	36.24	9.39
	Second solution	151.21	56.65	35.72	20.94
150 Salicylic	Distilled water	132.74	49.03	45.67	3.36
	First solution	154.40	55.32	36.38	18.94
	Second solution	161.27	61.63	28.69	32.94
25 Gibberellin	Distilled water	129.02	45.61	46.96	-1.35
	First solution	151.42	52.58	37.79	14.79
	Second solution	157.92	55.86	31.92	23.94
50 Gibberellin	Distilled water	140.09	52.66	42.03	10.63
	First solution	157.43	58.01	33.55	24.46
	Second solution	168.47	66.32	23.39	42.93
L.S.D %5 (AB)		7.00	2.58	4.63	6.17
Rates of growth regulators (mg.L <sup>-1</sup> ) (A)		Relative fresh weight (%)	Absorbed water (g/flower /day)	The lost water (g/flower /day)	water balance (g/flower /day)
Without adding		128.55	43.53	44.94	-1.41
100 Salicylic		142.19	49.88	40.75	7.47
150 Salicylic		149.47	55.33	36.91	18.41
25 Gibberellin		146.12	51.35	38.89	12.46
50 Gibberellin		155.33	59.00	32.99	26.01
L.S.D %5 (A)		4.04	1.49	2.67	3.56
Rates of preservative solutions (B)		Relative fresh weight (%)	Absorbed water (g/flower /day)	The lost water (g/flower /day)	water balance (g/flower /day)
Distilled water		128.91	45.33	48.02	-2.69
First solution		149.26	52.35	36.81	14.53
Second solution		154.82	57.78	31.85	25.92
L.S.D %5 (B)		3.13	1.15	2.07	2.76

**Second: The effect of growth regulators and preservative solutions and their interaction vase life, dry weight, carbohydrate content and total carotenoids content in petals.**

Table 2 shows that the treatment of flowers with growth regulators has significantly contributed to the effect on the quality of

Gladiolus flowers after cut Flowers. The results showed that treatment of GA3 (50 mg.L<sup>-1</sup>) was significantly excelled on the rest of the other treatments by giving it the highest vase life, dry weight, the carbohydrate content in the petals, and total carotenoids content in the petals of Gladiolus flowers reached of

(16.96 day, 22.89 g, 22.34 %, 7.84 mg/100g dry weight, respectively. While the control treatment gave the lowest values compared to the rest of the other treatments, as a vase life reached of 11.44 day, dry weight of flowers 19.05 g, carbohydrate content in petals 17.33% and the carbohydrate content in the petals of 5.76 mg/100g dry weight. The type of preservative solution affected significantly in maintaining the quality of flowers as long as possible. The treatment of the second solution was significantly excelled in the studied traits as shown in (Table 2) by giving it the highest values to the traits of the vase life gave of 17.24 day, dry weight for flowers 22.75 g, carbohydrate content in petals 22.13 %, total carotenoids content in petals 7.96 mg/100g dry weight. while the control treatment (distilled water) gave: vase life 11.42 day, dry weight for flowers 18.34 g, carbohydrate content in petals 16.96 %, total carotenoids content in

petals 5.49 mg/100g dry weight. The interaction which consisting of (50 mg.L<sup>-1</sup> GA3 + second solution) was significantly excelled on other interaction treatments in traits of the vase life of 21.25 day, the dry weight of the flower of 26.11 g, and the total carotenoids content in the petals of 10.06 mg/100g dry weight. As for the carbohydrate content in the flower petals, that the interaction which consist of (50 mg.L<sup>-1</sup> of GA3 + the second solution) and (Salicylic acid with concentration of 150 mg.L<sup>-1</sup> + the second solution) significantly excelled and without differences between them by giving of (24.84, 24.92%), respectively. While the control treatment gave the lowest values for traits of the vase life 9.17 day, dry weight of flowers 16.80 g, carbohydrate content in petals 14.65 % and the total carotenoids content in the petals of 4.82 mg/100g dry weight.

**Table 2. Effect of growth regulators and preservative solutions and the interaction between them in the vase life, dry weight, percentage of carbohydrates in petals and the total carotenoids content in the petals for Gladiolus flowers**

Growth regulators (mg.L <sup>-1</sup> ) (A)	Preservative solutions (B)	Vase life (day)	Dry weight of petals (g)	Percentage of carbohydrates in petals (%)	Total carotenoids content(mg/100g dry weight)
Without adding	Distilled water	9.17	16.80	14.65	4.82
	First solution	11.75	20.03	17.83	6.05
	Second solution	13.42	20.32	19.51	6.42
100 Salicylic	Distilled water	9.67	17.85	15.52	5.40
	First solution	12.69	20.89	18.67	6.59
	Second solution	15.58	21.98	20.49	7.40
150 Salicylic	Distilled water	12.87	17.87	16.63	5.69
	First solution	14.67	21.57	19.83	7.05
	Second solution	19.16	22.79	24.84	8.06
25 Gibberellin	Distilled water	11.67	18.76	17.11	5.57
	First solution	13.50	20.32	19.08	6.81
	Second solution	16.80	22.57	20.91	7.85
50 Gibberellin	Distilled water	13.75	20.42	20.87	5.99
	First solution	15.87	22.14	21.23	7.46
	Second solution	21.25	26.11	24.92	10.06
L.S.D %5 (AB)		0.44	3.27	3.27	1.48
Rates of growth regulators (mg.L <sup>-1</sup> ) (A)		Vase life (day)	Dry weight of petals (g)	carbohydrates in petals (%)	Total carotenoids content(mg/100g dry weight)
Without adding		11.44	19.05	17.33	5.76
100 Salicylic		12.65	20.24	18.23	6.46
150 Salicylic		15.57	20.74	20.43	6.93
25 Gibberellin		13.99	20.55	19.03	6.74
50 Gibberellin		16.96	22.89	22.34	7.84
L.S.D %5 (A)		0.26	1.89	1.89	0.85
Rates of preservative solutions (B)		Vase life (day)	Dry weight of petals (g)	carbohydrates in petals (%)	Total carotenoids content(mg/100g dry weight)
Distilled water		11.42	18.34	16.96	5.49
First solution		13.70	20.99	19.33	6.79
Second solution		17.24	22.75	22.13	7.96
L.S.D %5 (B)		0.20	1.46	1.46	0.66

The result showed that the treatment of (50 mg.L<sup>-1</sup> GA3) significantly excelled on the rest

of the other treatments for most studied traits. This is due to the effect of the Gibberellin acid

in maintaining the quality of flowers after cutting, Prolonging the vase life of Gladiolus flowers through delaying the senescence By delaying the activity of the enzyme Protase, which works to smashing proteins and Inhibition the process of peroxide fat, which may be one of the mechanisms responsible for the delay of senescence and has an important role in curbing the production of ethylene in the inflorescence, which encourages the start of the stage of senescence for flowers (6 , 20) and inhibition of the action of ethylene which causes the rapid fall of the petals, or due to the role of Gibberellin in the cells division and increase the size and expansion of flower cells as well as increase their absorption of water by increasing flexibility and elasticity for the walls and increase its expansion (7). Increasing the surface area of the cells leads to an increase in the amount of water withdrawn from the flowers for that water will enter rapidly causing the cells swelling (15). The Gibberellin works to reduce the loss of water from the flowers and reduce the transpiration that is associated with reduction in the permeability of the cellular membranes for the flowers (8) .GA3 has an important role in creating the water balance of cells and non-wilt and not to occur full flowering for flowers by maintaining the relationship between components of the water balance, which interfere strongly, which is the withdrawal of water, transfer and loss of water, and the ability of tissues to retain water (23). There is a continuous decline in water withdrawal by flowers with the length of its duration in the solutions and this leads to the lack of swelling of the cells. Gibberellin have an important role in swelling of cells and not losing dissolved materials from the cell ,which adversely affect the osmosis pressure and thus lead to increase the traits of studied in (Table 1). Due to Gibberellin controls in the enzymatic activity by activating the alpha-amylase enzyme, producing the carboxylase enzyme, activating nucleic acids and increasing sucrose absorbed, which is a source of energy and increasing its accumulation and reducing it in the petals and stimulate metabolism, especially the manufacture of carbohydrates dissolved (15,20) .Thus increases the total carbohydrate content for the flowers as shown in (Table 2).

Carbohydrate changes into the plant's metabolic pathways to Pyruvic acid, which converts into Acetyl COA. It enters into a series of vital processes leading to the formation of Carotenoides and thus increasing its total carotenoides in the petals of Gladiolus flowers (11). The results of the Tables (1,2) showed that the second preservative solution significantly excelled in most studied traits, Due to the components of preservative solution, which works together to maintain the vitality of flowers after the cut, Sucrose is one of the most important components of the preservative solution, as sucrose is transferred from the solution to the flowers to assemble in which. This leads to an increase in the concentration of the osmosis which accelerates the absorption of the solution and causes increased the bloating pressure and cause flowering and natural expansion of the petals and absorption of larger amounts of solution (9). It also leads to water tension, which is considered a determinant the vase life that expressed by the early wilt for leaves or flowers and that wilt occurs due to loss of cell swelling due to the imbalance between the quantity of water drawn from the base of the leg and water lost by transpiration, sucrose works to close the gaps to reduce transpiration and thus increase the traits studied in (Table 1) (19). The increased absorption of sucrose, which is used part of it in the process of breathing and the remaining part is used to increase dry weight, Sucrose also increases cell metabolism and produces the necessary nutrients for cell growth, thus increasing the accumulation of starch and sugars reducing in flowers and thus increasing the total carbohydrate for flowers (8) Increasing sucrose also improves the color of flowers by stimulating cells to produce enzymes necessary for the construction of plant pigments for Gladiolus flowers (16). The increase in the absorption of the solution is due to the role of 8-HQS in preventing the growth and accumulation of microorganisms in vase water or inside the carrier vessels in flower stem, Which will lead to blockage of these vessels and block the transmission of water and sugars to the top and that sucrose preserves the safety of cellular membranes (5).The presence of microorganisms in



conservation solution leads to the secretion of substances and enzymes that affect the pH of the solution and the development of harmful levels of ethylene. Therefore, the addition of 8-HQS leads to curbing the spread of microorganisms and prolonging the vase life of the *Gladiolus* flowers as shows in Table 2,1. The results of the interaction between growth regulators and preservative solutions for *Gladiolus* flowers was indicated, To the superiority of the treatment of the mixture consisting of (Salicylic acid of  $150 \text{ mg.L}^{-1}$  + the second solution) significantly in the relative weight increase relative to the flowers of *Gladiolus*, this may be due to the role of Salicylic in increasing the diameter of the vessels, which increases the absorption of the solution. It also prevents the oxidation of auxins and the internal cytokines. It also plays an important role in stimulating the genes necessary for the production of antioxidants, ion absorption and nutrient transport. The components of the chemical preservative solution work to supplying the flowers with water and energy requirements for the growth of flowers and prevent the proliferation of bacteria that cause the closure of vessels (4). As well as, the Gibberellin acid and the components of preservative solutions combined to play an important role in increasing the flexibility of cellular walls and absorption of water and sugars into the cells and reduce the rates of transpiration of flowers and thus reduce the lost water and the components of preservative solutions with growth regulators play an important role in maintaining the swelling of cells and thus maintain the water balance (12). The results of interaction in (Table 2) indicate that the best vase life for *Gladiolus* flowers to treatment that consist of ( $50 \text{ mg.L}^{-1}$  GA3 + second solution), this is due to the role of gibberellin in maintaining the quality of flowers by controlling in the enzymatic activity, nucleic acid formation, and stimulating of auxins, which play an important role in the division and expansion of cells, improve cell water relations and increase their absorption to preservative solution, Gibberellin reduce smashing of protein and accumulation of ammonia, inhibit protease activity and It promotes the opening of flower buds, the

preservative solutions work to supply flowers with the necessary growth requirements for the continuation of vital processes such as sucrose, citric acid and 8HQS, As these materials combined with Gibberellin to maintain the continuity of full bloating of the cells petals, non-wilting and maintaining high cell pressure. These materials supply the cells with the energy necessary for breathing operations and prevent the rapid destruction of nutrients in the petals and maintain the freshness of flowers and not lose the color of petals and maintain it for as long as possible because of the continuity of processing sucrose that sustains its metabolic processes, antimicrobials play an important role in reducing the bacterial spread that closes the vessels and prevents absorption of the solution, salicylic acid has an important role in maintaining the pH for the preservative solution, which accelerates the absorption of all the components of the preservative solution. In view of the above, the Gibberellin and preservative solutions work together in an interconnected way to prolong the vase life and increase the dry weight of the petals and the amount of carbohydrates and total carotenoids in the flower petals(14,24,26). The results showed that the use of growth regulators (GA3 and salicylic) played an important role in delaying the appearance of the senescence symptoms on the flowers of the *Gladiolus*, which lead to delay the physiological processes leading to the reduced of vase life of flowers, growth regulators gave the best results for all studied traits. The preservative solutions have a positive and significant effect on the increase of most of the studied traits due to the work of the components of preservative solutions (sucrose, 8-HQS, citric acid) combined in maintaining the quality of flowers after cut Flowers as a result to preventing the growth of microorganisms in the vessels stem and the continuity of flower supply with the necessary energy requirements for Biological processes. We recommend by using a combination of ( $50 \text{ mg/L}$  GA3, 5% sucrose +  $200 \text{ mg/L}$  8.HQS +  $200 \text{ mg.L}^{-1}$  citric acid) due to it gave the best results for the life of flowers after the cut Flowers.



## REFERENCES

1. Al-Mahdawy, M.I. 2009. Effect of Mineral Fertilization and Some Treatments on Growth and Flower Longevity of Two *Dianthus caryophyllus* L.Cultivars. Master's Degree in Agriculture Sciences. College of Agriculture and Forestry.University of Mosul. Iraq. pp:132
2. Alsahoeke, M. and K.M.Wahib.1990. Applications in the Design and Analysis of Agricultural Experiments. Ministry of Higher Education and Scientific Research of Iraq, pp: 480
3. Banaee, S. ; E. Hadavi and P. Moradi. 2013. Interaction effect of sucrose, salicylic acid and 8-hydroxyquinoline sulfate on vase-life of cut gerbera flowers. *Curr. Agri. Res.*, 1(1): 39-43
4. Bayat, H. and M. H. Aminifard. 2017. Salicylic acid treatment extends the vase life of five commercial cut flowers. *Electronic Journal of Biology* 13(1), 67-72
5. Chanjirakul, K. ; K. Sriboran and T. Satmitr .2014.The appropriate concentration of aluminum sulphate, 8-hydroxyquinoline sulphate and sucrose as a vase solution for replacement of a commercial vase solution for cut *Dendrobium*. In II International Orchid Symposium.1078 pp. 213-218
6. Danaee, E.; Y.Mostofi and P. Moradi. 2011. Effect of GA<sub>3</sub> and BA on postharvest quality and vase life of gerbera (*Gerbera jamesonii*.cv. Good timing) cut flowers. *Hortic. Environ Biotechnol.*, 52: 140–144
7. DeCosta, L. C.; F. F. D.Araujo ; P. C. Lima ; A. M. Pereira and F. L. Finger. 2016. Action of abscisic and gibberellic acids on senescence of cut gladiolus flowers. *Bragantia*, 75(4), 377-385
8. Elgimabia ,M. ; N. E. Eldeen and M.I. Yagi .2016. Different preservation solutions enhanced the vase life of Carnation cut flowers. *World Journal of Pharmaceutical and Life Sciences* . 2( 5): 32-41
9. Elhindi, K. M. 2012. Evaluation of several holding solutions for prolonging vase-life and keeping quality of cut sweet pea flowers (*Lathyrus odoratus* L.).*Saudi journal of biological sciences*, 19(2), 195-202
10. He, S. ; D.C. Joyce ; D.E. Irving, and J.D. Faragher .2006. Stem end blockage in cut grevillea, crimson yullo, in inflorescences *Postharvest Biol. Technol.*, 41:78-84
11. Jafarpour, M.; A.Reza Golparvar ; O. Askri Khorasgani and S.Amini .2015. Improving postharvest vase-life and quality of cut gerbera flowers using natural and chemical preservatives. *Journal of Central European Agriculture*, 16(2):1-15
12. Jalili Marandi, R.; A. Hassani ; A. Abdollahi and S. Hanafi . 2011. Application of *Carum copticum* and *Saturega hortensis* essential oils and salicylic acid and silver thiosulphate in increasing the vase life of cut rose flowers. *Journal of Medicinal Plants Research*. 5(20): 5034-5038
13. Joslyn, M.A. 1970. Methods In Food Analysis, Physical, Chemical and Instrumental Methods of Analysis, 2<sup>nd</sup> ed. Academic Press. New York and London. 13 (3): 23-36
14. Kadam, G. B. ; K. P. Singh and M. P. Singh. 2013. Effect of different temperature regimes on morphological and flowering characteristics in gladiolus . *Indian Journal of Plant Physiology*, 18(1), 49-54
15. Krzyminska, A.; M. Ulczyk Walorska and J. Bocianowski. 2014. Effect of hydroxyl quinoline sulfate and gibberellic acid on vase life of the cut inflorescence stems of *Sedum aizoon* L. *Bulgarian Journal of Agricultural Science*, 20 (5) 2014, 1098-1101
16. Kumar, R.; L. C. De; A. R. Roy and M. R.Verma . 2009. Effect of different holding solutions on post-harvest life of gladiolus (*Gladiolus hybridus*). *Indian Journal of Agricultural Sciences*.79(8):604-607.
17. Li, Hongbo. ; Li, Hongmei ; J. Liu ; Z. Lu ; D.Joyce and S. He .2017.Nano-silver treatments reduced bacterial colonization and biofilm formation at the stem-ends of cut gladiolus ‘Eerde’spikes. *Postharvest Biology and Technology*, 12(3): 102-111
18. Nosir, W.2010. Gladiolus Production in Soil-Less Culture and the Impact of *Trichoderma aharzianum* and *Aneurinobacillus migulanus* as Biological Control Agents.PhD Thesis In the Department of Plant and Soil Science School of Biological Science. College of Life Science and Medicine University of Aberdeen .UK.pp:189
19. Oraghi ardebili, Z.; V.Abdossi ;R. Zargarani and N. Oraghi ardebili.2013. The promoted longevity of gerbera cut flowers using geranyl diphosphate and its analog.

*Turkish Journal of Agriculture and Forestry*, 37(1), 45-51

20. Rabiza-Świder, J.; E. Skutnik ; A. Jędrzejuk ; A. Lukaszewska and K. Lewandowska. 2015. The effect of GA3 and the standard preservative on keeping qualities of cut LA hybrid lily ‘Richmond’. *Acta Sci. Pol. Hortorum Cultus*, 14(4), 51-64

21. Ranganna, S. 1999. *Handbook of Analysis and Quality Control for Fruit and Vegetable Products* (II Ed.).Tata Mc-Graw Hill publishing company Ltd: New Delhi.pp:58

22. Reid, M . S. 2004. *Produce Facts Gladiolus Recommendation for Maintaining Postharvest Quality*.Postharvest Technology Research and Information Center. University of California, Davies.pp:2

23. Sosa Nan, S.J. 2007. *Effects of Pre-and Postharvest Calcium Ementation on longevity of Sunflower Helianthus Annuus cv. Superior Sunset*. M.Sc. Thesis, Louisiana State University and Agricultural and Mechanical College, USA.pp: 96

24. Taher ,M. R. 2017. *Response of Ranunculus Plant to Pre and Postharvest Treatment with Polyamines (Putrescine and Spermidine) and Salicylic Acid*. College of Agriculture. University of Diyala.Iraq.pp:126

25. Tehranifar, A.; N.Vahdati; Y.Selahvarzi and H. Bayat.2013. *Treatment with salicylic acid extends the vase life of important commercial cut flowers*.*Advanced Crop Science*. 3(6): 405–413

26. Tomoko, T.; T. Yasumasa; K. Masakazu and M. Wataru .2008. *Anthocyanins of gladiolus cultivars and their contribution to flower colors*. *Journal of the Japanese Society for Horticultural Science*, 77(1), 80-87.