Academic Journal of Plant Sciences 15 (2): 09-17, 2022
ISSN 1995-8986

DOI: 10.5829/idosi.ajps.2022.09.17

Influence of Post-Harvest Treatments on *Philodendron bipinnatifidum* (Selloum) Cut Foliage

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Abstract: Cut foliage production has been rapidly increased in recent years and has played an important role in the national income. This study was conducted during two Successive seasons (2019 and 2020) at the Post-harvest Lab. of Ornamental Plants and Landscape Gardening Res. Dept., Hort. Res. Inst., Giza, Egypt, to investigate the effect of 9 different holding solutions on keeping quality and extending vase life of *Philodendron bipinnatifidum* (Selloum) cut leaves. The holding solutions were: Distilled water (DW), GA_3 at 50 ppm., GA_3 at 25 ppm., Calcium Chelate (100mg/l), Glycerol (2%), Glycerol (4%), GA_3 at 25 ppm+ 8-HQC at 400 ppm+ Sucrose (Suc.) at 30 g/l. , GA_3 at 50 ppm + 8-HQC at 400 ppm + Sucrose (Suc.) at 30 g/l. and Calcium Chelate (100mg/l.) + 8-HQC at 400 ppm + Sucrose (Suc.) at 30 g/l. The results emphasized that treating *Philodendron bipinnatifidum* cut leaves with different holding solutions improved the longevity, water uptake, percentage of fresh weight, dry weight and total carbohydrates, in addition to improving the general appearance. Moreover, these treatments decreased the carotenoids content and the degradation of chlorophyll *a* and *b* as compared to control (DW). Generally, all the studied holding solutions positively affected the longevity and keeping quality of *philodendron bipinnatifidum* (Selloum) cut leaves. GA_3 (50 ppm)+ 8-HQC (400 mg/l)+Suc.(30g/l) holding solution is the most preferable compared with the other holding solutions under room temperature.

Key words: Cut foliage・Vase life・General appearance・Sucrose (Suc)・8-Hydroxyquinoline citrate・Ca Chelate・GA_3・Glycerol

INTRODUCTION

Cut foliage occupies an important position. In the recent years it has demand in the local and foreign markets for increasing national income [1]. There are a suitable for environmental conditions, produce flower and foliage crops for local markets and exportation needs. So, recently the production of cut foliage has been increased rapidly.

Cut foliage plants are colorful and attractive plants which can be cut and put in a vase within homes. In addition to its uses in large quantities as a source of decoration on its own or in association with flowers in bouquets and floral arrangements to provide texture, interest and fill [2, 3].

Cut greens are important components of floriculture industry and largely used for decoration as filler in floral compositions [4]. They provide freshness and color to arrangements and bouquets.

Cut foliage as *Philodendron bipinnatifidum* (Selloum) are mainly placed in bouquets to add greenery and texture.

Philodendron bipinnatifidum is a tropical plant that is usually grown in full sun, Also, it has the ability for tolerance and adaptation in deep shade. With common names: split-leaf philodendron, lacy tree philodendron, Selloum, horse head philodendron is a plant in the genus *Thaumatophyllum*, in the family Araceae.

Glycerol is a simple polyol compound, colorless, odorless, viscous liquid that is sweet tasting and non-toxic. Its back bone was found in lipids known as glycerides. Due to having antimicrobial and antiviral properties which widely used in FDA approved wound and burn treatments. Completely miscible with water and many alcohols and also with many heterocyclic compounds as arranged with Megha *et al.* [5].

Glycerin preserves foliage used for replacing the natural moisture present in the leaf with a substance that

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maintains the leaf form, texture and sometimes the colour. Glycerin is a humectant that can be absorbed into plant tissue either by transpiration stream uptake or by immersing the cut foliage in the solution and preserves foliage by replacing the natural moisture present in the leaf with glycol and maintains the leaf form, texture and color [6].

Calcium Chelate is an EDTA cheated micro granule formulation that contains 9.5% calcium. Calcium Chelate is used for treatment of soils and crops where calcium deficiency is diagnosed or suspected.

Calcium (Ca^{+2}) is an important element that is found in 3% of the earth's crust [7]. It is essential to living organisms and to plant growth and development. Some of these benefits include stronger cell walls, increase postharvest life of flowering plants and as well as disease resistance [8, 9]. Ca is a major component in the cell wall of most plants in the form of Ca pectate. It is a relatively immobile element, but can become more mobile as the plant ages [8]. Plants that a deficient in Ca may have pale leaf margins and burned leaf edges among other symptoms [10].

Ca enhances initial fresh weight and delays its reduction rate. Ca treatments delay the decrease in petal membrane proteins and phospholipids and slow down the rate of electrolyte leakage from petals. It also suppressed ethylene production [11].

Gibberellins have been implicated in delaying foliar senescence of various cut flowers [12].

The physiology of the rapid development of foliar chlorosis is still unknown or attributed to the depletion of carbohydrate during storage may be the cause [13].

A positive effect of gibberellins in preventing premature leaf yellowing has been found in lily flowers [14]. GA_3 plays an important role in creating the water balance of cells [15].

Adding chemical preservatives to the holding solution is also recommended to prolong the vase life. All holding solutions must contain essentially two components; sugar and germicide. The sugar provides a respiratory substrate [16]. While the germicides control harmful micro organisms (bacteria, algae, yeasts and fungi) that block the stems xylem vessels and prevent water uptake [17]. Among all different types of sugar, Sucrose has been found to be the most commonly used in prolonging vase life, whereas 8-hydroxyquinoline (8-HQ) is the most powerful germicide [17, 18]. Moreover, Sucrose was found more effective when combining it with 8-HQ [16]. Several studies proved the great effect of their combination. Skutnik *et al.* [19] mentioned that the Sucrose and 8-HQC solution doubled vase life in *Asparagus denstiflorus* 'Meyerii'.

The aim of the present study was to explore the effect of various holding solutions on extending the longevity and keeping quality of *Philodendron bipinnatifidum* (Selloum) cut foliage.

MATERIALS AND METHODS

The present work was carried out at the Post-harvest Lab. of Ornamental Plants and Landscape Gardening Researches Department, Horticulture Researches Institute, Giza, Egypt, during the two seasons of 2019 and 2020. The aim of this study is to investigate the effect of Gibberellic acid (GA_3), 8-hydroxyqunoline citrate (8-HQC), Calcium Chelate (Ca), Glycerol and Sucrose (Suc.) as preservative holding solutions to enhance the quality and extending the vase life period of *Philodendron bipinnatifidum* (Selloum) cut leaves.

Plant Material: *Philodendron bipinnatifidum* (Selloum) cut leaves were obtained from local commercial ornamental farm on the 11 April in the first and second seasons. Cut leaves were fully mature, healthy, undamaged, evergreen and uniform leaves and transferred to the laboratory under dry conditions, cut leaves were re-cut to the length of 30 cm. After that, the cut leaves were transferred to glass jars (500ml) containing 300 ml of different holding solutions as follows:

T_1: Distilled water (DW) which was used as a control.
T_2: GA_3 at 50 ppm.
T_3: GA_3 at 25 ppm.
T_4: Calcium Chelate (100mg/l).
T_5: Glycerol (2%)
T_6: Glycerol (4%)
T_7: GA_3 at 25 ppm+ 8-HQC at 400 ppm + Sucrose (Suc.) at 30 g/l.
T_8: GA_3 at 50 ppm + 8-HQC at 400 ppm + Sucrose (Suc.) at 30 g/l.
T_9: Calcium Chelate (100mg/l) + 8-HQC at 400 ppm + Sucrose (Suc.) at 30 g/l.

All the afore mentioned treatments were kept in the laboratory under room temperature at 16±2°C and 50-60% relative humidity and continuous lighting with fluorescent lamps 1000 Lux to the end of the longevity.

Data Recorded: The following measurements were estimated during the vase life periods:

Water Relation: (a) water uptake (g/leaf), (b) water loss (g/leaf), (c) water balance (g/leaf), were recorded at 1, 8, 15 and 22 days during the vase life periods.

General Appearance: The quality of cut foliage was evaluated based a scale ranging, 1= bad (25%) [greenish yellow], 2= moderate (25% to >50%) [yellowish green], 3= good (50% to >75%) (Slightly yellowish) and 4= excellent (75% to100%) [Completely healthy leaves no wilting] as described by Sangwangkul *et al.* [20].

The Changing of Fresh Weight (%): It was recorded during the vase life period at 1, 8, 15 and 22 days during the vase life periods by the following equation:

- Flower weight at 1, 8, 15 and 22 days of vase life period (g) / flower weight at 0 day of vase life period (g) x100.

Vase Life (Days): were recorded at the end of cut leaves longevity.

Dry Weight of Leaves (g)

Chemical Composition: Pigments contents (chlorophyll a, b and carotenoids) (mg/g Fresh Weight) in the leaves after two weeks from the experiment start according to Moran and Porath [21].

- Total carbohydrates content (% of dry weight) in the leaves at the end of vase life, according to the methods described by Herbert *et al.*[22].

Layout and Statistical Analysis: The layout of the experiment was a complete randomized design with 9 treatments, each treatment contained 3 replicates and each replicate contained 3 leaves of philodendron. (9 treatments ×3 replicates× 3 leaves = 81 leaves, according to Snedecor and Cochran [23].

Data were tabulated and subjected to analysis of variance using MSTAT-C statistical software [24]. Means of treatments were compared by Duncan's Multiple Range Test at 5% level as indicated by Waller and Duncan [25].

RESULTS AND DISCUSSION

Effect of Different Holding Solutions on *Philodendron bipinnatifidum* (Selloum) Cut Foliage: General Appearance: It is obvious from Table (1) that score for Selloum cut foliage discoloration varied significantly among the vase solution. Minimum foliage discoloration score (3.0 and 3.0) was found from treating with [GA_3 (50 ppm) + Suc. (30 g/l) + 8-HQC (400 ppm)] followed by [GA_3 at 25 ppm + 8-HQC at 400 ppm + Suc. at 30 g/l which recorded (3.0 and 2.0)] in the two seasons, respectively while maximum foliage discoloration score was recorded from treating with [DW (0.0 and 0.0)] followed by [GA_3 25 ppm (1.0, 1.0)] and [GA_3 50 ppm (1.0, 1.5)] in both seasons respectively at 22[th] day after treating. These results agree with the findings of El-Shewaikh *et al*. [26] they recommended that holding cut foliage of *Chamaedorea elegans* in solution containing GA_3 at 50 ppm + BA at 20 ppm + 8-HQC at 300 ppm + CA at 300 ppm +Sugar (Sug.) at 2% improve cut leaves quality and extended vase life. These positive effects of GA_3 was due to delaying several processes involved in senescence including maintained an overall quality over the threshold of marketability, chlorophyll degradation, maintaining leaves coloration and delaying ethylene biosynthesis. Yellowing, drooping, wilting, or withering leads to the loss of the ornamental value of the florists' greens, which have great variation among species and cultivars in terms of the post-harvest longevity, the resistance to transport conditions and the storability [27, 28]. These findings are in line with Miceli *et al*. [29] on leaf lettuce and rocket.

Vase Life (Days): Results revealed that the application of different holding preservative solutions was effective in extending vase life period of Selloum cut foliage in comparison to the control as documented in Table(1). The best result in this regard was obtained from the treatment with T8 [GA_3 (50 ppm) + Suc. (30 g/l) + 8-HQC (400 mg/l) gave 19.72 and 20.56 days in the first and second seasons, respectively whilst the control treatment gave 8.89 days in the first season and 8.00 days in the second one. These results are in agreement with Amin [30] on cut Anthurium inflorescences and Zaky *et al*. [31] in a trial done on cut Fatsia leaves. Also, Ulczycka-Walorska and Krzyminska [32] mentioned that GA_3 extended the vase life of the cut leaves of *Viola odorata*. Similar results are observed by Farahat and Gaber [33], they stated that GA_3 at concentrations of 25 and 50 mg• dm^{-3} effectively extended the post-harvest longevity of *Monstera deliciosa*.

Water Relationships

Water Uptake: Results in Tables (2 and 3) showed that there are high moral differences very noticeable in water uptake of the persevered *philodendron bipinnatifidum* (Selloum) cut foliage as compared to among T_2 (GA_3 at 25 ppm), T_3 (GA_3 at 50 ppm), T_4 (Ca Chelate at 100mg) T_5 (Glycerol at 2%), T_6 (Glycerol at 4%), T_7(GA_3 at 25 ppm + 8-HQC at 400 ppm + Suc at30 g), T_8 (GA_3 at 50 ppm + 8-HQC at 400 ppm + Suc at 30 g) and T_9 (Ca Chelate at 100 mg+8HQC at 400 ppm+Suc at 30 g) as holding preservative solutions and T_1 (the control) treatment. Maximum vase solution was up taken by both T_7 (26.97 and 25.55 g/stem) and T_8 (26.99 and 27.95 g/stem) followed by T_5 (24.62 and 24.87 g/stem) compared to

Table 1: Effect of holding preservative solutions on general appearance (during the vase life period) and vase life (end of longevity) of *Philodendron bipinnatifidum* (Selloum) cut leaves in the two seasons (2019 and 2020)

Treatments	General appearance				Vase life (day)
	Season 2019				
	1st day	8th day	15th day	22th day	End of longevity
T1 (Control (DW))	4 a	2.72 b	0.67 c	0.00 d	8.89f
T2 (GA_3 at 25 ppm)	4 a	3.17ab	2.00 b	1.00 c	11.39e
T3 (GA_3 at 50 ppm)	4 a	3.44ab	3.33 a	1.00 c	13.67d
T4 (Ca Chelate at 100 mg)	4 a	3.00ab	1.50 b	0.00 d	11.11e
T5 (Glycerol at 2%)	4 a	3.72 a	3.67 a	2.00 b	18.56abc
T6 (Glycerol at 4%)	4 a	3.56ab	3.33 a	2.00 b	17.67bc
T7 (GA_3 at 25 ppm+8-HQC at 400 ppm+Suc at 30 g)	4 a	3.83 a	3.78 a	3.00 a	19.00ab
T8 (GA_3at50 ppm+ 8-HQC at 400 ppm + Suc at 30 g)	4 a	3.89 a	3.83 a	3.00 a	19.72 a
T9 (Ca Chelate at100 mg+8HQC at400 ppm+Sucat30g)	4 a	3.44ab	3.33 a	2.00 b	17.22c
	Season 2020				
T1 (Control (DW))	4 a	2.06 b	0.67 e	0.00 e	8.00f
T2 (GA_3 at 25 ppm)	4 a	2.33 b	1.83 cd	1.00 d	8.00f
T3 (GA_3at 50 ppm)	4 a	3.33 a	2.33 c	1.50 c	12.28e
T4 (Ca Chelate at 100 mg)	4 a	2.28 b	1.00 de	0.00 e	8.00f
T5 (Glycerol at 2%)	4 a	3.67 a	3.33 ab	2.00 b	17.83bc
T6 (Glycerol at 4%)	4 a	3.61 a	2.50 bc	1.83 b	16.33cd
T7 (GA_3 at 25 ppm+8-HQC at 400 ppm+Suc at 30 g)	4 a	3.83 a	3.50 a	2.00 b	18.17 b
T8 (GA_3at50 ppm+ 8-HQC at 400 ppm + Suc at 30 g)	4 a	3.89 a	3.83 a	3.00 a	20.56 a
T9 (Ca Chelate at100 mg+8HQC at400 ppm+Sucat30g)	4 a	3.44 a	2.33 c	1.00 d	14.89 d

Means followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test

Table 2: Effect of holding preservative solutions on water relationships (gm/1stem/4days) during the vase life period of *philodendron bipinnatifidum* (Selloum) cut leaves in the first season (2019)

Treatments	Water uptake (gm/1stem/4days)			
	1stday	8thday	15thday	22thday
T1 (Control (DW))	2.14h	17.75f	8.14e	0.00g
T2 (GA_3 at 25 ppm)	2.54f	18.95de	19.80d	11.02f
T3 (GA_3 at 50 ppm)	2.77e	18.99de	22.31c	14.89f
T4 (Ca Chelate at 100 mg)	2.36g	17.97 ef	18.53d	0.00g
T5 (Glycerol at 2%)	3.25b	20.64bc	28.64ab	24.62b
T6 (Glycerol at 4%)	3.07c	19.83cd	27.43b	23.12c
T7 (GA_3 at 25 ppm+8-HQC at 400 ppm+Suc at 30 g)	3.29b	21.35ab	29.63a	26.97a
T8 (GA_3at50 ppm+ 8-HQC at 400 ppm + Suc at 30 g)	3.43a	22.45a	30.06a	26.99a
T9 (Ca Chelate at100 mg+8HQC at400 ppm+Sucat30g)	2.89d	19.76cd	23.70c	20.64d
	Water loss (gm/1stem/4days)			
T1 (Control (DW))	3.11a	22.06 a	30.30a	0.00g
T2 (GA_3 at 25 ppm)	2.88b	20.86 abs	27.37b	26.76a
T3 (GA_3at 50 ppm)	2.64c	20.71 abc	25.35c	24.14a
T4 (Ca Chelate at 100 mg)	3.01ab	21.55 ab	28.54b	0.00g
T5 (Glycerol at 2%)	2.24ef	19.04 de	21.31d	20.81d
T6 (Glycerol at 4%)	2.33de	19.75 cd	21.42d	21.04c
T7 (GA_3 at 25 ppm+8-HQC at 400 ppm+Suc at 30 g)	2.19ef	18.14 e	20.19d	15.12e
T8 (GA_3at50 ppm+ 8-HQC at 400 ppm + Suc at 30 g)	2.11f	17.74 e	20.04e	9.35f
T9 (Ca Chelate at100 mg+8HQC at400 ppm+Sucat30g)	2.45d	20.61bc	24.03c	23.83b
	Water Balance (gm/1stem/4days)			
T1 (Control (DW))	-0.97i	-4.31h	-22.16h	0.00d
T2 (GA_3 at 25 ppm)	-0.34g	-1.91f	-7.57f	-15.74g
T3 (GA_3at 50 ppm)	0.13f	-1.72f	-3.04e	-9.25f
T4 (Ca Chelate at 100 mg)	-0.65h	-3.58g	-10.01g	0.00d
T5 (Glycerol at 2%)	1.01c	1.60c	7.33c	2.08c
T6 (Glycerol at 4%)	0.74d	0.08d	6.01c	0.08d
T7 (GA_3 at 25 ppm+8-HQC at 400 ppm+Suc at 30 g)	1.10b	3.21b	9.44b	11.85b
T8 (GA_3at50 ppm+ 8-HQC at 400 ppm + Suc at 30 g)	1.32a	4.71a	10.02a	15.64a
T9 (Ca Chelate at100 mg+8HQC at400 ppm+Sucat30g)	0.44e	-0.85e	-0.33d	-3.19e

Means followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test

Table 3: Effect of holding preservative solutions on water relationships (gm/1stem/4days) during the shelf-life period of *philodendron bipinnatifidum* (Selloum) cut foliage in the second season (2020)

Treatments	Water uptake (gm/1stem/4days)			
	1stday	8thday	15thday	22thday
T1 (Control (DW))	2.05g	16.19 d	7.33d	0.00f
T2 (GA_3 at 25 ppm)	2.28f	17.02 bcd	19.14c	9.73e
T3 (GA_3 at 50 ppm)	2.46e	17.11 bcd	20.78c	13.12d
T4 (Ca Chelate at 100 mg)	2.11g	16.31 cd	19.00c	0.00f
T5 (Glycerol at 2%)	3.01c	18.33 b	25.95b	24.87b
T6 (Glycerol at 4%)	2.88cd	17.85 bc	24.42b	22.53c
T7 (GA_3 at 25 ppm+8-HQC at 400 ppm+Suc at 30 g)	3.48b	21.79 a	26.34b	25.55b
T8 (GA_3at50 ppm+ 8-HQC at 400 ppm + Suc at 30 g)	3.80a	22.71 a	30.38a	27.95a
T9 (Ca Chelate at100 mg+8HQC at400 ppm+Sucat30g)	2.74d	17.57 bcd	24.35b	14.43d
	Water loss (gm/1stem/4days)			
T1 (Control (DW))	3.24a	23.36 a	30.23a	0.00h
T2 (GA_3 at 25 ppm)	2.77c	19.87 c	26.45b	24.01a
T3 (GA_3at 50 ppm)	2.49d	18.79cd	26.35b	23.74b
T4 (Ca Chelate at 100 mg)	3.10b	21.80 b	26.94b	0.00h
T5 (Glycerol at 2%)	2.14g	17.32 d	20.06cd	16.23e
T6 (Glycerol at 4%)	2.29f	17.95 d	20.98c	22.48d
T7 (GA_3 at 25 ppm+8-HQC at 400 ppm+Suc at 30 g)	2.09g	17.29 d	19.89c	14.00f
T8 (GA_3at50 ppm+ 8-HQC at 400 ppm + Suc at 30 g)	2.01h	17.20 d	19.01c	10.00g
T9 (Ca Chelate at100 mg+8HQC at400 ppm+Sucat30g)	2.36e	18.46cd	25.88b	22.99c
	Water balance (gm/1stem/4days)			
T1 (Control (DW))	-1.19i	-7.17h	-22.9h	0.00d
T2 (GA_3 at 25 ppm)	-0.49g	-2.85f	-7.31g	-14.28g
T3 (GA_3 at 50 ppm)	-0.03f	-1.68e	-5.57f	-10.62f
T4 (Ca Chelate at 100 mg)	-0.99h	-5.49g	-7.94g	0.00d
T5 (Glycerol at 2%)	0.87c	1.01c	5.89c	8.59c
T6 (Glycerol at 4%)	0.59d	-0.10d	3.44d	0.05d
T7 (GA_3 at 25 ppm+8-HQC at 400 ppm+Suc at 30 g)	1.39b	4.50b	6.45b	11.55b
T8 (GA_3at50 ppm+ 8-HQC at 400 ppm + Suc at 30 g)	1.79a	5.51a	11.37a	17.95a
T9 (Ca Chelate at100 mg+8HQC at400 ppm+Sucat30g)	0.38e	-0.89de	-1.53e	-8.56e

Means followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test.

(0.00 and 0.00 g/stem) from the control till the 22th day in the two seasons, respectively. The obtained results may be a reflection of using biocides that help in inhibiting the effect of micro organisms in blocking the vascular system that causes decline in water uptake and plant cell breakdown thus, allowing greater hydration in leaves and it is suggested that the increase in the water uptake by Sucrose treatments could be due to the increase in the osmotic concentration of the florets and leaves Pun and Ichimura [16] on different cut flowers. glycerine solution 10% was effective in uptake method Biswajit *et al*. [34] on *Nephrolepis exaltata.* Also, Emongor [35] mentioned that Gerbera cut-flowers held in 2.5, 5 or 7.5 mg L^{-1} GA_3 had significantly higher water content in the flower heads and stems, hence maintaining flower turgidity.

Water Loss: According to data presented in Tables (2 and 3) showed highly significant differences between all the treatments when compared with T_1 (control) treatment which gave (30.30 and 30.23g/1stem), till 15th day. While T_8 had the superiority treatment in the 22thday as it was (9.35 and 10.00 g/stem) in both seasons respectively. The afore mentioned results are in well agreement with Lü *et al*. [36] on cut rose who mentioned that treating Solidago with 300 ppm 8-HQS + 40 g/l Sucrose gave the lowest value of water loss [37]. Also, Rosanne and Susan [38] confirmed that treating excised leaves (Easter lily) with 500 mg/l of Gibberellic acid lowered the transpiration rate.

Water Balance: It is evident from data presented in Tables (2 and 3) proved that T_8 achieved the highest values until 22th day, as it gave 15.64 and 17.95 g/stem followed by T_7 gave 11.85 and 11.55 g/stem, a similar trend was also obtained regarding the effect of T_5 which recorded a water balance 2.08 and 8.59 g/stem until 22th compared to - 22.16 and -22.9 g/stem resulting from T_1 (the control treatment) till 15th day, respectively in the two seasons of this experiment. Increasing the rate of water balance in presence of antiseptic solutions may be attributed to the role of HQ as described by Jowkar *et al.* [39] indicates that HQC is known to inhibit ethylene

Table 4: Effect of holding preservative solutions on the changing of leaves fresh weight (%) during the vase life period of *Philodendron bipinnatifidum* (Selloum) cut leaves in the two seasons (2019 and 2020)

	The changing of leaves fresh weight (%)			
	Season 2019			
Treatments	1st day	8th day	15th day	22th day
T1 (Control (DW))	-3.26e	-2.41f	1.09g	0.00g
T2 (GA_3 at 25 ppm)	-2.78abc	4.47 b	7.61c	0.19f
T3 (GA_3 at 50 ppm)	-2.86bc	2.77 c	3.78d	0.41e
T4 (Ca Chelate at 100 mg)	-3.25de	-2.27f	1.14g	0.41e
T5 (Glycerol at 2%)	-3.00cd	0.31 e	1.24g	0.44de
T6 (Glycerol at 4%)	-2.91bc	0.76 d	1.62f	0.51d
T7 (GA_3 at 25 ppm+8-HQC at 400 ppm+Suc at 30 g)	-2.67ab	8.06a	9.06b	1.27b
T8 (GA_3at50 ppm+ 8-HQC at 400 ppm + Suc at 30 g)	-2.58a	8.13a	11.50a	2.14a
T9 (Ca Chelate at100 mg+8HQC at400 ppm+Sucat30g)	-2.82abc	2.52 c	2.98e	0.82c
	Season 2020			
T1 (Control (DW))	-2.54a	8.90a	13.10a	0.00f
T2 (GA_3 at 25 ppm)	-2.70a	5.27c	6.03c	-1.25h
T3 (GA_3at 50 ppm)	-2.81ab	3.53d	3.77d	-0.78g
T4 (Ca Chelate at 100 mg)	-2.59a	8.11b	9.28b	0.00f
T5 (Glycerol at 2%)	-3.28c	1.89f	2.11g	0.37e
T6 (Glycerol at 4%)	-3.13bc	2.06f	2.41f	0.53d
T7 (GA_3 at 25 ppm+8-HQC at 400 ppm+Suc at 30 g)	-3.74d	-1.23g	0.33h	0.99b
T8 (GA_3at50 ppm+ 8-HQC at 400 ppm + Suc at 30 g)	-3.98d	-2.40h	0.14i	1.48a
T9 (Ca Chelate at100 mg+8HQC at400 ppm+Sucat30g)	-2.62a	2.37e	2.82e	0.86c

Means followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test

Table 5: Effect of holding preservative solutions on the dry weight (g) and carbohydrates (%) in leaves of *philodendron bipinnatifidum* (Selloum) cut leaves in the two seasons (2019 and 2020)

	Dry weight (g)		Carbohydrates (%)	
Treatments	2019	2020	2019	2020
T1 (Control (DW))	1.11 d	0.78 f	5.20 g	6.61 f
T2 (GA_3 at 25 ppm)	1.14d	1.23 d	6.84 ef	10.04 d
T3 (GA_3at 50 ppm)	1.23c	1.34 c	7.70 e	10.45 d
T4 (Ca Chelate at 100 mg)	1.14d	1.11 e	6.53 f	8.39 e
T5 (Glycerol at 2%)	1.50b	1.61 b	11.79 c	13.59 b
T6 (Glycerol at 4%)	1.41b	1.56 b	10.62 d	12.14 c
T7 (GA_3 at 25 ppm+8-HQC at 400 ppm+Suc at 30 g)	1.62a	1.65 b	13.47 b	14.70 a
T8 (GA_3at50 ppm+ 8-HQC at 400 ppm + Suc at 30 g)	1.65a	2.04 a	14.66 a	15.37 a
T9 (Ca Chelate at100 mg+8HQC at400 ppm+Sucat30g)	1.26c	1.35 c	9.85 d	11.66 c

Means followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test

production in cut flowers and suppressed bacterial growth in vase solution. Sucrose effect on enhancing the vase life of cut flowers is associated with water balance. The application of Sucrose treatment and sugars accumulated in the flowers increase the sugar and osmotic concentration improve water absorption and flower turgidity [40-42]. Also, similar results are observed by Elshereef [37] who confirmed that carnation cut flowers were treated by 300 ppm 8-HQS +40 g/l Sucrose caused highest level of water balance and the best results were found by using 50ppm GA_3 for 24h., then placed in 200 ppm Al_2 $(SO4)_3$. GA_3 plays an important role in creating the water balance of cells Al-Hasnawi *et al*. [15] on gladiolus. Moreover, Water balance that is created by the loss of moisture from the leaf blades, or by the blockage of the conducting vessels preventing water uptake, that is the most important reason for the ageing of florists' greens [43, 44].

The Changing of Fresh Weight (%): A declining trend throughout 1st day after postharvest treatments of *Philodendron bipinnatifidum* (Selloum) cut foliage was noticed in Table 4. After that fresh weight % had an incremental increases to 15 day then the increase

Table 6: Effect of holding preservative solutionson chlorophyll a, b and carotenoids (mg/mg F.W.) of *philodendron bipinnatifidum* (Selloum) cut foliage after two weeks from experiment initial in the two seasons (2019 and 2020)

Treatments	Chlorophyll a (mg./g.F.W.)		Chlorophyll b (mg./g.F.W.)		Carotenoids (mg./g.F.W.)	
	2019	2020	2019	2020	2019	2020
T1 (Control (DW))	1.96 f	1.82 g	0.47 f	0.32 f	2.81 a	2.78 a
T2 (GA_3 at 25 ppm)	2.42 e	2.71 e	0.89 e	1.02 de	1.63 e	2.06 de
T3 (GA_3at 50 ppm)	2.70 de	3.22 d	1.14 d	1.27 cd	1.65 e	2.17 cde
T4 (Ca Chelate at 100 mg)	2.39 e	2.57 f	0.71 e	0.89 e	1.58 e	2.01 e
T5 (Glycerol at 2%)	3.92 b	3.81 b	1.66 c	1.83 b	2.49 bc	2.59 ab
T6 (Glycerol at 4%)	3.17 c	3.80 b	1.31 d	1.77 b	2.35 c	2.38 bc
T7 (GA_3 at 25 ppm+8-HQC at 400 ppm+Suc at 30 g)	4.48 a	3.84 b	1.95 b	1.92 b	2.66 ab	2.65 a
T8 (GA_3at50 ppm+ 8-HQC at 400 ppm + Suc at 30 g)	4.77 a	4.12 a	2.37 a	2.20 a	1.05f	1.50f
T9 (Ca Chelate at100 mg+8HQC at400 ppm+Sucat30g)	2.95 cd	3.68 c	1.15 d	1.37 c	2.00 d	2.28 cd

Means followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test

decreases till 22[th] day. On the other hand, T_8 (GA_3 at 50 ppm + 8-HQC at 400 ppm + Suc at 30 g) was the most effective holding solution for increasing the fresh weight percentage as compared to the other treatments followed by T_7 (GA_3 at 25 ppm + 8-HQC at 400 ppm + Suc at 30 g) in the two seasons, respectively.

In the same trend, Kamaladin *et al.* [45] reported that all vase solutions contained 200 mg•dm^{-3} 8-hydroxyquinoline citrate (8-HQC) and 3% Sucrose delayed fresh weight loss. 10 mM CH treatment was the most effective for delaying fresh weight loss on lisian thus (*Eustoma grandiflorum* L.) cut flowers. As for, GA_3 conditioning of *Gerbera jamesonii* resulted in a mass increase [46]. Similarly, 8HQS, it might have a positive effect on changes in plant mass, as shown by Elhindi [47] and Asrar [48] for *Lathyrus odoratus* and *Antirrhinum majus*, respectively.

Dry Weight (g): It is clear from data presented in Table (5) that all treatments promoted dry weight, the data indicated that T_8 is the best holding solutions increased dry weight in cut leaves after end the vase life (1.65 and 2.04 g)in first and second seasons, respectively. These results agreed with El-Deeb *et al*. [49] who recommended that holding unrooted cutting of *Dracaena marginata* in solution containing GA_3 at 50 ppm + BA at 20 ppm + 8-HQC at 300 ppm + CA at 300 ppm + Sug. at 2% GA_3 at 50 ppm + BA at 20 ppm + 8-HQC at 300 ppm + CA at 300 ppm + Sug. at 2%, gave the heaviest dry weight. Also, Emongor [35] found that Gibberellic acid at 2.5, 5 or 7.5 mg L^{-1} significantly reduced dry matter content in the flower heads and stems of gerbera cut-flowers.

Total Carbohydrates Content (%): Data recorded in Table (5) cleared that T8 as a holding solution significantly scored the best values in total carbohydrates content (%) in leaves of *Philodendron bipinnatifidum* (Selloum) (14.66 and 15.37%) compared to the control (DW) and the other treatments in the two seasons. These results agreed with El-Deeb *et al*. [49].

Chlorophyll a, b and Total Carotenoids Contents (mg/g Fresh Weight): As shown in Table (6) the data indicated that T_8 (GA_3 at 50 ppm + 8-HQC at 400 ppm + Suc at 30 g) as a holding solution recorded the highest values of chlorophyll a and b content in *philodendron bipinnatifidum* (Selloum) leaves (4.77 and 4.12 mg/g FW) for chlorophyll a and (2.37 and 2.20 mg/g FW) for chlorophyll b compared to the control. (1.96 and 1.82 mg/g FW) for chlorophyll a and (0.47 and 0.32 mg/g FW) for chlorophyll b and the same treatment gave the lowest value of total carotenoids (1.05 and 1.50 mg/g FW) compared to the control (2.81 and 2.78 mg/g FW) for the two seasons, respectively. In previous studies Buchanan-Wollaston *et al.* [50] and Skutnik *et al.* [51] concluded that a decrease in the chlorophyll content is the first visual symptom of leaf ageing. Also, Janowska and Stanecka [52] found that the beneficial effect of GA_3 on the chlorophyll content of Zantedeschia leaves with colored spathes.

Recommendation: From the previous study, it can be recommended that holding *philodendron bipinnatifidum* (Selloum) cut leaves in solution containing GA_3 at 50 ppm/l + 8-HQC at 400 ppm/l + Sucrose (Suc) at 30 g/l have the majority in improving quality and prolonging vase life.

REFERENCES

1. Abou El-Ghait, E.M., A.O. Gomaa, A.S.M. Youssef and Y.F. Mohamed, 2012. Effect of some post harvest treatments on vase life and quality of chrysanthemum (*Dendranthema grandiflorum* Kitam) cut flowers. Res. J. Agric. Biol. Sci., 8(2): 261-271.

2. Pacifici, S., A. Ferrante, A. Mensuali-Sodi and G. Serra, 2007. Postharvest physiology and technology of cut Eucalyptus branches: a review. Agric. Med., 137: 124-131.
3. Reid, M.S. and C.Z. Jiang, 2012. Postharvest biology and technology of cut flowers and potted plants. In: Horticulture Reviews (Eds. Jules Janick): 1-54.
4. Bhattacharjee, S.K., 1999. Post-harvest management of cut flowers, cut foliage and post production of potted plants. J. Orn. Hort, New series, 2(1): 32-39.
5. Megha, N., S.E. Topno, S.S. Saravanan and V. Bahadur, 2019. Effect of Glycerin drying on preservation of different ornamental Foliage. International Journal of Chemical Studies, 7(4): 1205-1208.
6. Bale, S., 2006. Preserving Flowers and Foliage. Website:www.ca.uky.edu/agc/pubs/ho/ho70/ho70.pdf.
7. Campbell, A.K., 1983. In: Intracellular Calcium: Its universal role as regulator. John Wiley and Sons Ltd., New York, pp: 1-12.
8. Anghileri, L.J., 1982. The role of calcium in Biological Systems. CPC Press, Inc., Boca Raton, Fl, pp: 176-191.
9. Starkey, K.R. and A.R. Pedersen, 1997. Increased levels of calcium in the nutrient solution improves the postharvest life of potted roses. J. Amer. Soc. Hort. Sci., 122(6): 863-868.
10. Schraer, H., 1970. In: Biological Calcification: Cellular and Molecular Aspects. Appelton Century Crofts Corporation, N.Y., pp: 378.
11. Torre, S., A. Borochov and A.H. Halevy, 1999. Calcium regulation of senescence in rose petals. Physiol. Plant., 107: 214-219.
12. Han, S., 1995. Growth regulators delay foliar chlorosis of Easter lily leaves. J. Amer. Soc. Hort. Sci., 120: 254-258.
13. Miller, B., 1993. The physiology of *Lilium longiflorum* flower bulbs in: A.DeHertogh and M. Lenarad (eds). Elsevier, Amsterdam, pp: 391-422.
14. Sindhu, S.S. and N.S. Pathania, 2004. Effect of pulsing, holding and low temperature storage on keeping quality of Asiatic lily hybrid. Acta Hort., 624: 389-394.
15. Al-Hasnawi, H.A., J.K. Hussein and T.H. Khaleel, 2019. Effect of growth regulators and preservative solution on vase life and water relation of *Gladiolus hybrida* L. after cut flowers. Iraqi J. Agric. Sci., 50: 182-191.
16. Pun, U.K. and K. Ichimura, 2003. Role of sugars in senescence and biosynthesis of ethylene in cut flowers. Jaro, 4: 219-224.
17. Faragher, J., T. Slater, D. Joyce and V. Williamson, 2002. Postharvest Handling of Australian Flowers from Australian Native Plants and Related Species, a Practical Workbook. Rural Industries Research and Development Corporation (RIRDC) Barton, ACT, Australia.
18. Elgimabi, M.N. and O.K. Ahmed, 2009. Effects of bactericides and Sucrose-pulsing on vase life of rose cut flowers (Rosa hybrida).Botany Research International, 2(3): 164-168.
19. Skutnik, E., J. Robiza-Swider and A.J. Lukaszewska, 2006. Evaluation of several chemical agents for prolonging vase life in cut Asparagus greens Journal of Fruit and Ornamental Plant Research, 14: 233-240.
20. Sangwangkul, P., P. Saradhuldhat and R.E. Paull, 2008. Survey of tropical cut flower and foliage responses to irradiation. Postharvest Bio. and Techno., 48: 264-271.
21. Moran, R. and D. Porath, 1980. Chlorophyll determination in intact tissues using NN-dimethyl formamid. Plant Physio., 65: 478-479.
22. Herbert, D., P.J. Philips and R.E. Strange, 2005. Determination of Total Carbohydrates. Methods in Microbiology, 58: 209-344.
23. Snedecor, C.W. and W.G. Cochran, 1982. Statistical Methods. 7th ed. The Iowa State Univ. Prss Ames. Iowa, USA.
24. MSTAT-C Statistical Software, 1989. User's guide: a microcomputer program for the design, management and analysis of agronomic research experiments. Michigan University, East Lansing, MC, USA.
25. Waller, A. and D.B. Duncan, 1969. Multiple ranges and multiple tests. Biomet., 11: 1-24.
26. El-Shewaikh, Y., E.A. El-Deeb and H.Z. El-Sadek, 2018. Effect of some post-harvest treatments on cut leaves of *Chamaedorea elegans.*Sci. J. Flowers and Ornamental Plants., 5(1): 31-44.
27. £ukaszewska, A., E. Skutnik, F. Przewodnik and S.G.G.W. Wydawnictwo, 2003. Effect of Glycerin drying on preservation of different ornamental Foliage. International Journal of Chemical Studies., 7(4): 1205-1208.
28. Janowska, B., 2010. Effect of conditioning on the longevity of leaves of the Italian arum (Arum italicum Mill.) kept at a low temperature. NaukaPrzyr. Technol., 4: 12.
29. Miceli, A., F. Vetrano, L. Sabatino, F. D'Anna and A. Moncada. 2019.Influence of Preharvest Gibberellic Acid Treatments on Postharvest Quality of Minimally Processed Leaf Lettuce and Rocket Horticulturae, 5: 63; doi:10.3390/horticulturae5030063.

30. Amin, O.A., 2017. Influence of Nanosilver and Stevia extract on cut Anthurium Inflorescences. Middle East Journal of Applied Sci., 07: 299-313.
31. Zaky, A.A., S.Z. El-Bably and S.A.M. Khenizy, 2008. Effect of Gibberellic acid, some antitranspirants and postharvest treatments on the quality of cut Fatsia leaves. Minufiya J. Agric. Res., 33(4): 1011-1024.
32. Ulczycka-Walorska, M.P. and A. Krzyminska, 2022. The Effect of 8-Hydroxyquinoline Sulphate and Gibberellic Acid on Postharvest *Viola odorata* L. Leaf Longevity. Agriculture, 12: 247.
33. Farahat, M.M. and A. Gaber, 2010. Influence of preservative materials on postharvest performance of cut window leaf foliage (*Monstera deliciosa*). Acta Horti., 877: 1715-1720.
34. Biswajit, K., S. Chakrabarty, A. Hayat and S. Bagchi, 2020 Processing of *Nephrolepis exaltata* with Glycerine to Enhance Shelf Life by Drying Int. J. Curr. Microbiol. Appl. Sci., 93: 348-356.
35. Emongor, V.E., 2004. Effects of Gibberellic Acid on Postharvest Quality and Vaselife of Gerbera Cut Flowers (*Gerbera jamesonii*). Journal of Agronomy, 3: 191-195.
36. Lü, P., S. He, H. Li, J. Cao and H. Xu, 2010. Effects of Nano-silver treatment on vase life of cut rose cv. Movie Star flowers. Journal of Food Agriculture & Environment., 8(2): 1118-1122.
37. Elshereef, A.Y., 2015. Effect of Some Postharvest Treatments on Some Cut Flowers. M.Sc.Ornamental Horticulture Department, Fac. of. Agri. Cairo Uni., Egypt, pp: 156.
38. Rosanne, E.F. and H.S. Susan, 2004. Respiratory changes associated with growth regulator in Ester Lily. Hort. Sci., pp: 21.
39. Jowkar, M.M., M. Kafi, A. Khalighiand N. Hasanzadeh, 2012. Evaluation of aluminum sulfate as vase solution biocide on postharvestmicrobial and physiological properties of ‘Cherry Brandy’ rose. Annals of Biological Research, 3(2): 1132-1144.
40. Reddy, B.S. and K. Singh, 1996. Effects of aluminium sulphate and Sucrose on vase life of tuberose. J. Maharashtra Agri.Uni., 21(2): 201-203.
41. Prashanth, P., R.C. Sekhar and K.C.S. Reddy, 2010. Influence of floral preservatives on scape bending, bio-chemical changes and postharvest vase life of cut gerbera (*Gerbera jamesonii* Bolus ex. Hook.). Asian. J.Horti., 5(1): 1-6.
42. Bhanusref, M.R., N.H. Rao, M. Chandrica, M. Vinayku- Mari, K.R. Kumar, G. Shukla and S. Chakravarty, 2015. Effect of Sucrose on biochemical parameters of cut gerbera flowers (*Gerbera jamesonii* Bolus ex. Hook.)cv. Lamborghini. J.Agric. Technol., 2(1&2): 68-71.
43. Hayden, D.H., 2003. Characterization of senescence regulated gene expression in Anthurium. Ph.D. Thesis, Uni. Hawaii Library, Honolulu, HI, USA, pp: 105.
44. Skutnik, E. and J. Rabiza-Œwider, 2005. Effect of pulsing with growth regulators on senescence of the detached cold-stored leaves of *Zantedeschia aethiopica* Spr. and Hosta "UndulataErromena, 7: 4-7.
45. Kamaladin, S., H. Moazzam, R. Zeynab and S. Muhammad, 2014. Effect of 8- hydroxyquinoline citrate, Sucrose and peroxidase inhibitors on vase life of Lisianthus (*Eustoma grandiflorum* L.) cut flowers. J. Horti. Res., 22(1): 41-47.
46. Danaee, E., Y. Mostofi and P. Moradi, 2011. Effect of GA_3 and BA on postharvest quality and vase life of Gerbera (*Gerbera jamesonii cv.*Good Timing) cut flowers. Horti. Envir. Bio., 52: 140-144.
47. 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 J. Biol. Sci., 19: 195-202.
48. Asrar, A.W.A., 2012. Effects of some preservative solutions on vase life and keeping quality of snapdragon (*Antirrhinum majus* L.) cut flowers. J. Saudi Soc. Agric. Sci., 11: 29-35.
49. El-Deeb, E.A., H.Z. El-Sadek and Y.M.E. El-Shewaikh, 2018. Effect of some post-harvest treatments on unrooted cutting of *Dracaena marginata*. Sci. J. Flowers & Ornamental Plants, 5(1): 45-56.
50. Buchanan-Wollaston, V., E. Earl, E. Harrison, E. Mathas, S. Navabpour, T. Page and D. Pink, 2003. The molecular analysis of leaf senescence– a genomics approach. J. Plant Bio., 1: 3-22.
51. Skutnik, E., J. Rabiza-Swider, M. Wachowicz and A. £ukaszewska, 2004. Senescence of cut leaves of *Zantedeschia aethiopica* and Z. elliottiana. Part I. Chlorophyll degradation. Acta. Sci. Pol-HortorumCultus, 3: 57-65.
52. Janowska, B. and A. Stanecka, 2011. Effect of growth regulators on the postharvest longevity of cut flowers and leaves of the Calla lily (Zantedeschia Spreng). Acta Agrobot., 64: 91-98.