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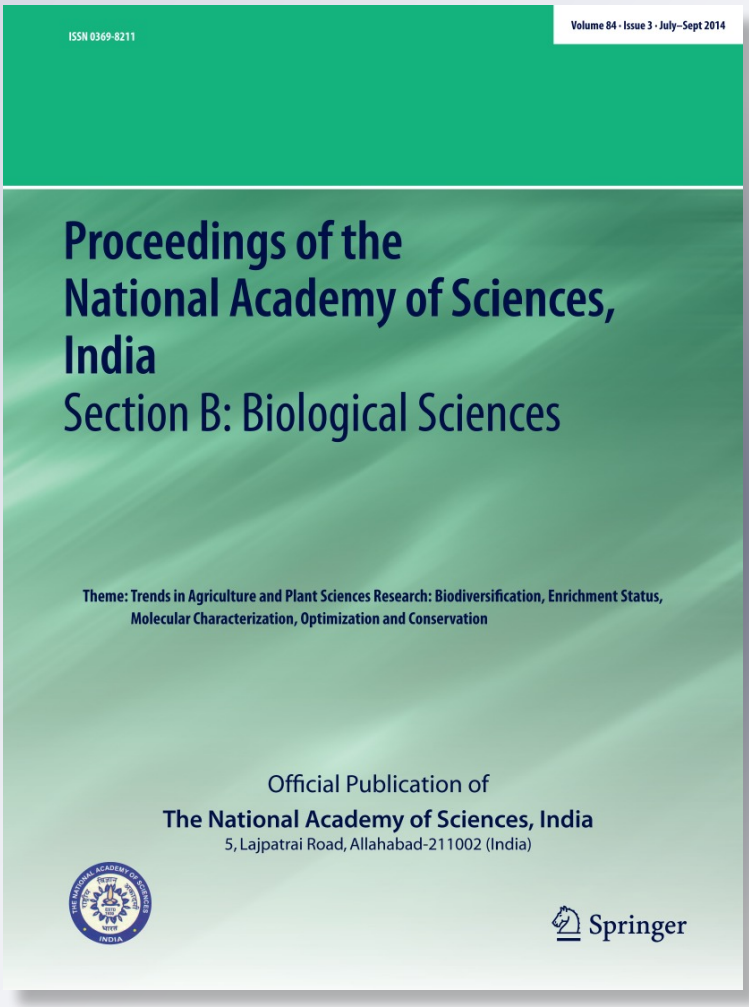

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RESEARCH ARTICLE

Effect of Pulsing on Postharvest Longevity of Cut Leaves of Lace Fern/Bridal Fern (*Asparagus setaceus* syn. *Plumosus*)

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Abstract Loss of appealing quality characteristics and rapid desiccation within a short period after detaching from mother plants is one of the major problems in cut foliages. Effect of pulsing with benzyl adenine (BA), 8-Hydroxy Quinoline citrate (8-HQC) and sucrose on vase life of cut leaves of *Asparagus setaceus* syn. *Plumosus* was investigated. Two durations of pulsing viz., 12 and 24 h were employed. Pulsing for 12 h with BA (25 ppm) + 8-HQC (200 ppm) + 10 % sucrose resulted in higher fresh weight at senescence.The lowest physiological loss in weight was registered by the cut foliages pulsed for 24 h with BA (25 ppm) + 8-HQC (200 ppm) + 10 % sucrose. Pulsing the cut foliages for 24 h with BA (25 ppm) + 8-HQC (200 ppm) + 10 % sucrose resulted in the maximum uptake of water and registered the highest water balance. The lowest transpirational loss of water was found to be associated with foliages pulsed with 10 % sucrose alone for 24 h. The foliages pulsed with BA (25 ppm) + 8-HQC (300 ppm) + 10 % sucrose for 24 h registered lowest ratio between water loss and water uptake. Results suggest that application of 10 % sucrose+BA (25 ppm) + 8-HQC (200 ppm) as a pulse treatment for 24 h can be recommended to prolong the postharvest life (28.50 days) through delayed leaf senescence and thus enhance the marketability of cut leaves of *Asparagus setaceus* syn. *Plumosus*.

Keywords Cut foliage · Pulsing · Sucrose · Vase life · Water balance

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Introduction

Lace fern or Bridal fern (*Asparagus setaceus* syn. *Plumosus*) is an extremely feathery and soft long branched fern, belonging to the family Liliaceae. It is a climber, growing up to 5 m with horizontal fern like dark green fronds on slender smooth green stems. It has a trailing appearance. Cladodes (flattened stems looking like leaves) are numerous per axil. Cladodes and lateral branches are arranged in the same plane. Scale leaves are spine-like. Flowers occur singly or in pairs, at the end of branches which are tiny and greenish white in colour. Lacy Asparagus Fern is native to Africa, and is grown mainly for its ornamental foliage or as a garden plant. It is extensively used by florists in floral decorations and is a wonderful potted plant for use in terrariums and container gardens. Its ornamental foliage is both an ideal foundation for presentation style bouquets and makes a complementary backdrop to most other floral

designs. It can be used as cascading focal points in large designs and serves as an excellent greenery in delicate flower bouquets. Therefore it is indispensable to elaborate the most efficient post harvest handling methods of ornamental asparagus on every step of the market chain from a grower through a wholesaler and finally to a consumer [1]. In flower arrangements, all elements should be characterized by more or less the same vase life. However, the florist green frequently first loses its ornamental value in a flower arrangement, since it quickly wilts, fades, or browns. That is why it is important to develop agents for pulsing cut florist greens that would extend its vase life effectively and inhibit senescence [2]. Pulse conditioning with benzyl adenine (0.1 mmol dm^{-3} BA) delays symptoms characteristic to senescence in cut shoots of *Asparagus setaceus* [3]. Pulsing is of great advantage during handling and marketing of cut foliages. Pulsing is carried out by the grower which requires no additional treatment by the customers. The present study was formulated to identify suitable pulsing treatments that would enhance the vase life of cut foliage of *Asparagus setaceus* syn. *Plumosus*.

Material and Methods

Plant Materials and Laboratory Procedures

The cut foliages of *Asparagus setaceus* syn. *Plumosus* were obtained from plants grown in shade net-house in the Floriculture unit of the Division of Horticulture, Gandhi Krishi Vigyana Kendra, University of Agricultural Sciences, Bangalore, Karnataka during the year 2011–2012. Foliages which were having uniform size, free from pests and diseases were selected and harvested using sharp secateur for assessing the keeping quality. Their cut ends were immersed in distilled water immediately after harvest and were brought to the laboratory for imposing the treatments. The cut foliages were graded for uniformity and stems were recut under water using sterile, sharp scalpels before imposing the treatments. Different treatment solutions were prepared with benzyl adenine (BA), 8-Hydroxy Quinoline citrate (8-HQC) and sucrose. Freshly prepared solutions were used for conducting the experiment. The experiments were conducted at ambient condition in the post harvest laboratory, at relative humidity of 58–65 % and at a temperature of 20–23 °C. The experiment was laid out in two factorial completely randomised design with eighteen treatments and two replications. The treatment details are given below.

Chemicals used for pulsing-9

P_1: Benzyl adenine (25 ppm) + 10 % sucrose
P_2: Benzyl adenine (50 ppm) + 10 % sucrose
P_3: 8-HQC (200 ppm) + 10 % sucrose
P_4: 8-HQC (300 ppm) + 10 % sucrose
P_5: Benzyl adenine (25 ppm) + 8-HQC (200 ppm) + 10 % sucrose
P_6: Benzyl adenine (50 ppm) + 8-HQC (200 ppm) + 10 % sucrose
P_7: Benzyl adenine (25 ppm) + 8-HQC (300 ppm) + 10 % sucrose
P_8: Benzyl adenine (50 ppm) + 8-HQC (300 ppm) + 10 % sucrose
P_9: Control

Duration of pulsing: 2

D_1: 12 h
D_2: 24 h

Details of the Experimental Procedure

Cut foliages of *Asparagus setaceus* syn. *Plumosus* with uniform stalk length were selected. Each foliage stalk was maintained under each replication in a test tube containing 100 ml of the aqueous solutions of different pulsing chemicals. Two durations of pulsing viz., 12 and 24 h were employed. After pulsing treatment the vase life was evaluated by keeping the cut foliages of *Asparagus setaceus* syn. *Plumosus* in test tubes containing 120 ml distilled water. One stalk of the foliage was used per treatment in two replications in the experiment.

Foliage Evaluation

Observations were recorded for various vase life attributes as mentioned below to study the vase life of cut foliages of *Asparagus setaceus* syn. *Plumosus* through pulsing.

Initial Fresh Weight of Cut Asparagus

The difference between the weight of glass bottle+water+cut asparagus and weight of glass bottle+water on initiation of vase life experiment was recorded as initial fresh weight of cut asparagus. It was expressed in grams.

Weight of Cut Asparagus at Senescence

The difference between the weight of glass bottle+water+cut asparagus and weight of glass bottle+water on termination of the experiment was recorded as weight of cut asparagus at senescence. It was expressed in grams.

Physiological Loss

Physiological loss in weight was calculated by using the following formula. It was expressed in percentage.

$$\text{PLW} = \frac{\text{IW}_a - \text{FW}_a}{\text{IW}_a} \times 100$$

where IW_a : initial fresh weight of cut asparagus and FW_a : final weight.

Total Amount of Pulsing Solution

The difference between initial weight and final weight of pulsing solution was measured and expressed as total amount of pulsing solution absorbed in grams.

Water Uptake

The difference between the weight of the jars with out the foliage at the end of the shelf life period and the weight of the jars with out foliage at the beginning of experiment represented water uptake in grams for that period.

$$\text{Water uptake } (WU_A) = U_{Ia} - U_{Fa}$$

where, U_{Ia} = weight of the vase solution at the beginning of experiment

U_{Fa} = weight of the vase solution at the end of the vase life period

Water Loss

Water loss (g/foliage) was measured as the difference between the weight of the jars with the foliage at the end of the shelf life period and the weight of the jars with foliage at the beginning of experiment.

$$\text{Water loss } (WL_A) = L_{Ia} - L_{Fa}$$

where, L_{Ia} = combined weights of the foliage and vase solution at the beginning of experiment and L_{Fa} = combined weights of the foliage and vase solution at the end of the shelf life period

Water Balance

Water balance in cut asparagus was calculated as the difference between water uptake and transpirational loss of water presented as gram per foliage

$$\text{Water balance} = WU_A - WL_A$$

where, WU_A = water uptake and WL_A = water loss.

Water Loss

Water Uptake Ratio

Ratio between water loss and water uptake was calculated and expressed as Water loss: Water uptake ratio. The overall vase life was set as the number of days the cut foliage of *Asparagus setaceus* syn. *Plumosus* remained fresh in distilled water. It was expressed in days.

Experimental Design and Data Analysis

The experiment was arranged in Factorial Completely Randomised Design (Factorial CRD) with eighteen treatments and two replications. The data were subjected to statistical analysis as per the established procedure [4]. The results have been presented and discussed at a probability level of 0.05 or 5 % probability.

Results and Discussion

The data on different vase life parameters as influenced by pulsing treatment with different chemicals and duration of pulsing and their interactions in *Asparagus setaceus* syn. *Plumosus* are presented in Tables 1 and 2.

Initial Fresh Weight of *Asparagus setaceus* syn. *Plumosus*

The data pertaining to initial fresh weight of cut asparagus Cv. *Asparagus setaceus* syn. *Plumosus* did not show significant difference either due to different pulsing chemicals or due to duration of pulsing including their interaction effects. The foliages of *Asparagus setaceus* syn. *Plumosus* used for the experiment did not vary with respect to initial fresh weight since the cut foliages which were having uniform size were selected and harvested for assessing the keeping quality.

Weight at Senescence and Physiological Loss in Weight

Among the different pulsing treatments with chemicals, the treatment P_5 (25 ppm BA + 200 ppm 8-HQC supplemented with 10 % sucrose) recorded significantly higher weight of the foliage (6.25 g) at senescence and the lowest physiological weight loss (16.52 %). Least weight at senescence (0.88 g) and highest physiological loss in weight (88.39 %) was observed in foliages treated with 10 % sucrose alone. Normally the treatment resulting in less physiological weight loss percentage of foliages is considered good because these may result in longer vase life as compared to those showing more ones. Pulsing for 24 h recorded the highest values for weight (4.00 g) at senescence and least physiological loss in weight (48.08 %). However, the foliages pulsed for 12 h recorded least weight at senescence (3.47 g) and highest physiological loss in weight (54.68 %) (Table 1). Among the

Table 1 Vase life attributes of *Asparagus setaceus* syn. *Plumosus* as influenced by chemicals used for pulsing and duration of pulsing

Treatments	Initial fresh Weight (g)	Weight at senescence (g)	Physiological loss in weight (%)	Water uptake (g)	Water loss (g)	Water balance	Amount of pulsing solution absorbed (g)	Water loss: water uptake ratio	Vase life (days)
Chemicals used for pulsing									
P_1 25 ppm BA + 10 % sucrose	8.25	4.50	46.23	19.75	20.07	−0.32	3.25	1.02	16.00
P_2 50 ppm BA + 10 % sucrose	8.75	3.75	55.40	14.25	15.77	−1.52	2.25	1.11	12.25
P_3 200 ppm 8-HQC + 10 % sucrose	7.75	2.50	67.21	15.75	16.78	−1.03	2.50	1.07	13.75
P_4 300 ppm 8-HQC + 10 % sucrose	8.00	2.75	66.21	12.25	14.91	−2.66	1.75	1.22	12.00
P_5 25 ppm BA + 200 ppm 8-HQC + 10 % sucrose	7.50	6.25	16.52	26.28	25.36	0.91	7.50	0.97	25.25
P_6 50 ppm BA + 200 ppm 8-HQC + 10 % sucrose	5.50	3.00	45.83	23.50	22.77	0.73	4.00	0.96	20.75
P_7 25 ppm BA + 300 ppm 8-HQC + 10 % sucrose	8.25	5.25	36.46	20.75	20.21	0.54	3.50	0.98	18.75
P_8 50 ppm BA + 300 ppm 8-HQC + 10 % sucrose	8.00	4.75	40.13	17.50	19.91	−2.41	2.75	1.14	16.00
P_9 Control (10 % sucrose)	7.5	0.88	88.39	5.98	11.25	−5.23	0.88	1.84	9.25
F TEST	NS	*	*	*	*	*	*	*	*
S.Em ± CD @ 5 %	0.61	0.29	5.20	0.35	0.40	0.12	0.37	0.01	0.34
	1.81	0.86	15.51	1.04	1.18	0.35	1.09	0.04	1.02
Duration of pulsing									
D_1 12 h	7.67	3.47	54.68	16.88	18.38	−1.50	2.69	1.17	15.44
D_2 24 h	7.78	4.00	48.08	17.78	18.74	−0.95	3.61	1.12	16.56
F TEST	NS	*	NS	*	NS	*	*	*	*
S.Em ± CD @ 5 %	0.29	0.14	2.45	0.16	0.19	0.06	0.17	0.01	0.16
	0.85	0.40	7.31	0.49	0.56	0.17	0.52	0.02	0.48

NS Non significant

*Significant

Table 2 Interaction effect of chemicals used for pulsing and duration of pulsing on vase life attributes of *Asparagus setaceus* syn. *Plumosus*

Treatments		Initial fresh weight (g)	Weight at senescence (g)	Physiological loss in weight (%)	Water uptake (g)	Water loss (g)	Water balance	Amount of pulsing solution absorbed (g)	Water loss: water uptake ratio	Vase life (days)
P_1D_1	25 ppm BA + 10 % sucrose—12 h	7.50	3.50	53.57	19.50	19.97	−0.47	3.00	1.02	14.50
P_1D_2	25 ppm BA + 10 % sucrose—24 h	9.00	5.50	38.89	20.00	20.16	−0.16	3.50	1.01	17.50
P_2D_1	50 ppm BA + 10 % sucrose—12 h	8.50	2.00	76.39	14.00	14.90	−0.90	2.00	1.06	12.00
P_2D_2	50 ppm BA + 10 % sucrose—24 h	9.00	5.50	34.42	14.50	16.64	−2.14	2.50	1.15	12.50
P_3D_1	200 ppm 8-HQC + 10 % sucrose—12 h	7.50	3.00	59.82	15.50	16.17	−0.67	2.50	1.04	14.00
P_3D_2	200 ppm 8-HQC + 10 % sucrose—24 h	8.00	2.00	74.60	16.00	17.39	−1.39	2.50	1.09	13.50
P_4D_1	300 ppm 8-HQC + 10 % sucrose—12 h	9.00	4.00	53.25	11.50	14.40	−2.90	1.50	1.25	12.50
P_4D_2	300 ppm 8-HQC + 10 % sucrose—24 h	7.00	1.50	79.17	13.00	15.43	−2.43	2.00	1.19	11.50
P_5D_1	25 ppm BA + 200 ppm 8-HQC + 10 % sucrose—12 h	8.00	6.50	18.75	24.50	23.73	0.78	4.50	0.97	22.00
P_5D_2	25 ppm BA + 200 ppm 8-HQC + 10 % sucrose—24 h	7.00	6.00	14.29	28.05	27.00	1.05	10.50	0.96	28.50
P_6D_1	50 ppm BA + 200 ppm 8-HQC + 10 % sucrose—12 h	5.50	2.00	63.33	22.50	21.79	0.71	4.00	0.97	20.50
P_6D_2	50 ppm BA + 200 ppm 8-HQC + 10 % sucrose—24 h	5.50	4.00	28.33	24.50	23.75	0.75	4.00	0.97	21.00
P_7D_1	25 ppm BA + 300 ppm 8-HQC + 10 % sucrose—12 h	8.00	5.00	37.50	20.50	20.39	0.11	3.50	0.99	18.50
P_7D_2	25 ppm BA + 300 ppm 8-HQC + 10 % sucrose—24 h	8.50	5.50	35.42	21.00	20.03	0.97	3.50	0.95	19.00
P_8D_1	50 ppm BA + 300 ppm 8-HQC + 10 % sucrose—12 h	7.50	4.50	39.29	16.50	19.10	−2.60	2.50	1.16	16.50
P_8D_2	50 ppm BA + 300 ppm 8-HQC + 10 % sucrose—24 h	8.50	5.00	40.97	18.50	20.73	−2.23	3.00	1.12	15.50
P_9D_1	Control (10 % sucrose)—12 h	7.50	0.75	90.18	7.45	15.00	−7.55	0.75	2.01	8.50
P_9D_2	Control (10 % sucrose)—24 h	7.50	1.00	86.61	4.50	7.50	−3.00	1.00	1.68	10.00
F TEST		NS	*	*	*	*	*	*	*	*
S.Em ± CD @ 5 %		0.86	0.41	7.35	0.49	0.56	0.17	0.52	0.02	0.49
		2.56	1.21	21.94	1.48	1.67	0.50	1.55	0.06	1.45

NS Non significant

*Significant

interactions, pulsing with 25 ppm BA + 200 ppm 8-HQC + 10 % sucrose for 12 h recorded significantly maximum weight at senescence (6.50 g). Pulsing with 25 ppm BA + 200 ppm 8-HQC + 10 % sucrose for 24 h recorded the lowest physiological loss in weight (14.29 %). Least weight at senescence (0.75 g) and highest physiological loss in weight (90.18 %). was recorded by foliages treated with 10 % sucrose for 12 h (Table 2). Foliages held in 25 ppm BA+200 ppm 8-HQC + 10 % sucrose for 12 h and then transferred to water were heavier and maintained their fresh weight longer than cut foliages held in 10 % Sucrose alone. Cut foliages held in 10 % sucrose alone showed incipient wilting whereas those held in 8-HQC + BA + sucrose were turgid. The decrease in fresh weight of foliages held in 10 % sucrose alone may be due to reduced water absorption. 8-HQC prevents vascular blockage and allows greater solution uptake [5]. Sugar in the pulsing solution also maintained higher fresh weight by inducing stomatal closure in the leaves. These data suggest that a foliage grower might treat cut foliages and "condition" them to maintain fresh weight till the end of vase life. Pulsing is a short term pre-shipment treatment with high concentration of sucrose and with various other chemicals, the effect of which should last throughout the shelf life of the cut foliages even when they are held under water. It is clear, from data in Table 2 that adding or supplementing 10 % sucrose with preservatives containing 8-HQC and BA decreased foliage weight loss percentage. This may be attributed to the effect of BA in delaying senescence and foliage wilting coupled with the effect of sucrose that served as the building blocks and supplied the required energy thus reducing the rate of respiration. The supplemented sucrose provided sufficient intracellular carbohydrate reserves to ensure a lower weight loss and 8-HQC served as an excellent anti -microbial agent. Holding solution containing 8-HQS+BA+sucrose reduced the respiration rate and physiological loss in weight of spikes of dendrobium hybrid sonia-17 [6].

Total Volume of Pulsing Solution Absorbed

It is clearly evident from Table 1 that maximum amount of pulsing solution was absorbed (7.50 g) by pulsing the foliages with 25 ppm BA + 200 ppm 8-HQC(P_5) supplemented with 10 % sucrose as compared to pulsing with sucrose alone (0.88 g). The total volume of pulsing solution absorbed (3.61 g) was maximum when pulsed for 24 h. Pulsing the foliage for 12 h resulted in absorption of least volume (2.69 g) of pulsing solution (Table 1). Among the interaction effects (Table 2) pulsing the foliages with 25 ppm BA + 200 ppm 8-HQC + 10 % sucrose for 24 h is proved to be the best with regard to total volume of pulsing solution absorbed (10.50 g). Least volume (0.75 g) of pulsing solution was absorbed when foliages where pulsed with sucrose alone for 12 h.

Water Loss

Among the different chemicals used for pulsing, the treatment P_5 (25 ppm BA + 200 ppm 8-HQC supplemented with 10 % sucrose) recorded significantly higher loss of water (25.36 g) whereas those pulsed with 10 % sucrose recorded least water loss (11.25 g).Water loss of *Asparagus setaceus* syn. *Plumosus* was found to be non-significant with respect to duration of pulsing. However, pulsing for 24 h recorded the highest values for water loss (18.74 g), while the least (18.38 g) was observed in foliages pulsed for 12 h (Table 1). Among the interaction effects (Table 2), the treatment involving pulsing cut foliages for 24 h with 25 ppm BA+200 ppm 8-HQC + 10 % sucrose (P_5D_2) resulted in the maximum water loss (27.00 g) as compared to pulsing with 10 % sucrose alone (7.50 g) for 24 h. The maximum transpirational loss of water in P_5D_2 might be due to the synergistic effect of germicide, growth regulator and energy source in taking up the maximum amount of water. Once the cells became turgid, the condition is generally favourable for the stomata to open. This factor might have acted upon in effecting the maximum transpiration loss of water. The findings are in agreement with the observations of Aarts [7], Doorn et al. [8], Mokadem et al. [9] and Patil [10].

Water Relations

The foliages pulsed with 25 ppm BA + 200 ppm 8-HQC + 10 % sucrose (P_5) exhibited higher water uptake (26.28 g), positive water balance (0.91) whereas those pulsed in 50 ppm BA + 200 ppm 8-HQC + 10 % sucrose exhibited the lowest (0.96) water loss to uptake ratio closely followed by 25 ppm BA + 200 ppm 8-HQC + 10 % sucrose (0.97). Least water uptake (5.98 g), least water balance (−5.23) and highest water loss to uptake ratio (1.84) was observed in P_9 (10 % sucrose). Pulsing for 24 h recorded significantly higher water uptake (17.78 g), water balance (−0.95) and lowest (1.12) water loss to uptake ratio. Pulsing for 12 h resulted in least water uptake (16.88 g), least water balance (-1.50) and highest water loss to uptake ratio (1.17) (Table 1).

Pulsing the cut foliages with 25 ppm BA + 200 ppm 8-HQC + 10 % sucrose for 24 h (P_5D_2) recorded highest water uptake (28.05 g) and highest water balance (1.05). The foliages pulsed with 25 ppm BA + 300 ppm 8-HQC + 10 % sucrose for 24 h had the lowest water loss and uptake ratio (0.95), closely followed by P_5D_2 (25 ppm BA + 200 ppm 8-HQC + 10 % sucrose—24 h) with ratio of 0.96. The foliages pulsed in 10 % Sucrose alone for 12 h had least water uptake, least water balance, maximum water loss and uptake ratio of 4.50 g, −7.55 and 2.01 respectively. Results regarding the water uptake by the cut

foliages in the present study showed that maximum water was taken up by the foliages pulsed in 25 ppm BA + 200 ppm 8-HQC + 10 % sucrose for 24 h followed by those pulsed in 50 ppm BA + 200 ppm 8-HQC + 10 % sucrose for 24 h. When foliages are detached from the mother plant, water loss from these continues through transpiration. The ideal flower preservative is that which allows water absorption in flower tissues [11]. Microorganisms, which grow in vase water, include bacteria, yeasts and moulds. These are harmful to cut foliages as they lead to blockage of xylem at cut ends, preventing the water absorption. They also produce ethylene and toxins, which accelerate foliage senescence and reduce vase-life. Adding a suitable germicide in pulsing solution can check the growth of microbes. In the present study 8-HQC served as an effective bactericide for the extension of vase-life. Their mode of action is associated with control of microbial activity [12]. These results are in agreement with previous workers who have reported reduced vascular blockage, and increased water uptake of *Gladiolus* cut flowers when placed in 8-HQC [5]. Concerning the water balance in cut leaves of *Asparagus setaceus* syn. *Plumosus* during shelf life periods after pulsing in preservative solutions, data in Table 2 showed that cut foliage turgidity is the result of the balance between the level of water uptake and water loss. The gains in cut foliage fresh weight can occur when the rate of water uptake is greater than respiration. This also depends upon how the foliage is able to retain the absorbed water. In the present study foliages pulsed for 24 h in 25 ppm BA + 200 ppm 8-HQC + 10 % sucrose recorded the highest water balance while least water balance was recorded in control. Sucrose along with other floral preservatives improved the water balance. This was attributed to the effect of sugar on the closure of stomata there by, increasing their ability to absorb water and maintain turgidity [13]. Generally, these results reveal that preservative solutions showed promotive effects on water balance. These results are in agreement with those obtained in roses [14] wherein after treatment with 6-BA, the water absorption capacity of cut flowers exerted a dual effect in delaying senescence by increasing water uptake and reducing water loss, thereby improving water balance. Similar results were reported in *Schefflera arboricola* cut foliage [15]. *Dianthus caryophyllus* cut flowers treated with vase solution containing sucrose + 8-HQC + Citric acid + Tween-20 increased water loss with increasing shelf life periods [16]. Similar results were reported in *Gerbera jamesoni.* [17].

Vase Life

Vase life is an important parameter for evaluation of cut foliage quality for both domestic and export market. In the present investigation, foliages pulsed in 25 ppm BA + 200 ppm 8-HQC + 10 % sucrose significantly increased the vase life (25.25 days). Least value for vase life (9.25 days) was registered in P_9 (10 % sucrose alone). Pulsing for 24 h showed better results for vase life (16.56 days), while the foliages pulsed for 12 h had a lower vase life of 15.44 days (Table 1). The treatment combination P_5D_2 (25 ppm BA + 200 ppm 8-HQC + 10 % sucrose—24 h) significantly increased the vase life by 28.50 days. Least vase life (8.50 days) was recorded by foliages treated with 10 % Sucrose alone and pulsed for 12 h (Table 2). Addition of chemical preservatives to the pulsing solution is recommended to prolong the vase-life of cut flowers and foliage. Most floral preservatives contain carbohydrates, germicides, ethylene inhibitors, growth regulators and some mineral compounds [12]. The preservative materials used as pulsing or holding solutions seemed to prolong longevity. In this study, chemical preservatives like HQC or BA alone or in combination with sucrose were used to prolong vase life of *Asparagus setaceus* syn. *Plumosus*. Sucrose was the kind of sugar mostly used in floral preservatives. It was reported that vase life, general appearance, fresh mass and medium uptake of *Gladiolus* inflorescences were improved with sucrose treatment [18]. Sucrose uptake from the pulsing solution replenished intercellular respirable carbohydrates, allowing a sustained high respiration rate and prolonged vase life. Increased vase life due to sucrose may result from decreased moisture stress and improved water balance [19]. Vase solutions containing 4 % sucrose increased water uptake and transpirational loss, and increased fresh weight of spikes of *Gladiolus* as compared with control [20]. Beneficial effect of pulsing solutions containing 8-HQC on the vase life of cut foliage could be assumed to be the result of its powerful biocidal activity. 8-HQC will decrease the pH of water thereby reduces stem plugging, and thus showed positive effect in increasing the vase life of cut foliages. Extension of vase life by cytokinin could be due to reduction in overall respiration rate. Cytokinin helps to regulate senescence by improving water balance. Benzyl adenine has been reported to increase the vase life of *Alstroemeria* cut flowers [21].

In conclusion, the present results suggest that pulsing the foliages in combinations of sucrose with 25 ppm BA + 200 ppm 8-HQC, increased vase life of *Asparagus setaceus* syn. *Plumosus* considerably.

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