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Impact of various holding solutions on the quality and longevity of *Asparagus densiflorus*cv. 'sprengeri'

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ABSTRACT

The experiment was designed to study the effect of various holding solutions on the longevity and quality of Asparagus densiflorus cv. 'Sprengeri'. The experiment comprised of five treatments using three chemicals viz., sucrose @ 10 %, BA @ 25, 50 ppm, nanosilver @ 20, 40 ppm and citric acid @ 200 ppm along with control (tap water). The experiment was laid out in completely randomized design (CRD) with four replications. The holding solution with sucrose 10 % + BA 25 ppm + nanosilver 40 ppm + citric acid 200 ppm (T_3) recorded minimum cumulative physiological loss in weight (33.41 %), maximum cumulative transpirational loss of water (27.97 g.foliage^{-1}), maximum cumulative water uptake (28.26 g.foliage^{-1}), positive water balance (1.33), least optical density (0.1278), maximum vase life (8.84 days), maximum colour index (93.6 %) and chlorophyll content index (9.37) followed by T_4 (sucrose 10 % + BA 50 ppm + nanosilver 40 ppm + citric acid 200 ppm).

Key words: Asparagus, Sprengeri fern, holding solution, sucrose, BA, nano silver and citric acid.

INTRODUCTION

Cut foliage industry is an integral part of the green industry, which goes hand-in-hand with the cut flower industry. Modern cut flower industry cannot survive without the cut foliage industry and this has emerged as a blooming industry in many countries. The huge demand of flowers particularly during off-season or lean period, create a vacuum and real problem for the flower user. Cut foliage has enough potentiality as an alternative for flowers particularly during lean period but they remain unexploited (Rajeevan and Geetha, 2006). Asparagus ferns are excellent filler materials for bouquets and are highly valued as florist greens due to their elegant symmetry and lush green foliage. Sprengeri fern (*Asparagus densiflorus* cv. 'Sprengeri') is a herbaceous tender evergreen perennial belonging to the family Liliaceae is a favourite choice for garlands, wreaths and bridal bouquets. When placed in a hanging pot, the fern branches hang down from the pot for a wild, delicate, touch of nature to any home. Owing to foliage's delicacy and tenderness, they are extremely susceptible to mechanical and physical damage and infection also by diseases and pests during and after harvest. Thus, to minimize the proneness and on the basis of aforesaid reports revealed that good quality along with longer vase life can be ensured by the utilization of chemical preservatives. Chutichudet *et al.*, (2011) reported that among the various practices for enhancing the vase life of cut flowers, carbohydrates, preservatives, growth regulators, germicides and organic acids plays a major role. Physiological and biological processes of floral preservatives are well known which enables rapid changes in the post harvest quality and vase life of cut flowers. They are known for their influence on water relation (absorption and transpiration) and also ethylene (accelerates senescence of flowers). With the above facts in mind, the present investigation was carried out to study the effect of nano silver and other preservatives used as holding solutions on vase life of *Asparagus densiflorus* cv. 'Sprengeri'.

MATERIALS AND METHODS

The present investigation was carried out at the Floriculture complex, Department of Horticulture, Annamalai University, Annamalai Nagar during 2018-2019. An experiment was laid out in completely randomized design with four replications and 5 treatments. The treatments were: T_1- Sucrose 10 % + BA 25 ppm + Nanosilver 20 ppm + Citric acid 200 ppm, T_2- Sucrose 10 % + BA 50 ppm + Nanosilver 20 ppm + Citric acid 200 ppm, T_3- Sucrose 10 % + BA 25 ppm + Nanosilver 40 ppm + Citric acid

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200 ppm, T_4- Sucrose 10 % + BA 50 ppm + Nanosilver 40 ppm + Citric acid 200 ppm and T_5- Control (Tap water). Cut foliages of *Asparagus densiflorus* cv. 'Sprengeri'with uniform stalk length of 30 cm were selected. Twofoliage stalks was maintained under each replication in glass bottle containing 200 ml of different holding solutions. Two stalks of the foliage was used per treatment in four replications in the experiment. Observations were recorded on Cumulative physiological loss in weight (CPLW), Cumulative transpirational loss of water (CTLW), Cumulative uptake of water (CUW), Water balance, Optical density of vase solution, Vase life, Colour index and Chlorophyll content index.

RESULTS AND DISCUSSION

Cumulative physiological loss in weight (CPLW)

CPLW differed significantly among all the treatments and the treatment T_3 (sucrose 10 % + BA 25 ppm+ nanosilver 40 ppm + citric acid 200 ppm) excelled other treatments by recording the lowest cumulative physiological loss in weight (33.41 %), followed by T_4 (sucrose10 % + BA 50 ppm + nanosilver 40 ppm+ citric acid 200 ppm) with the value of 40.72 %, while the highest CPLW (87.45 %) was found in control (Fig.1). This was in accordance with the results of Reid *et al.* (2008) in cut roses. This may be due to antimicrobial characteristics of nano silver which prevent the foliage from vascular occlusion, reduced water stress (Morones *et al.*, 2005).

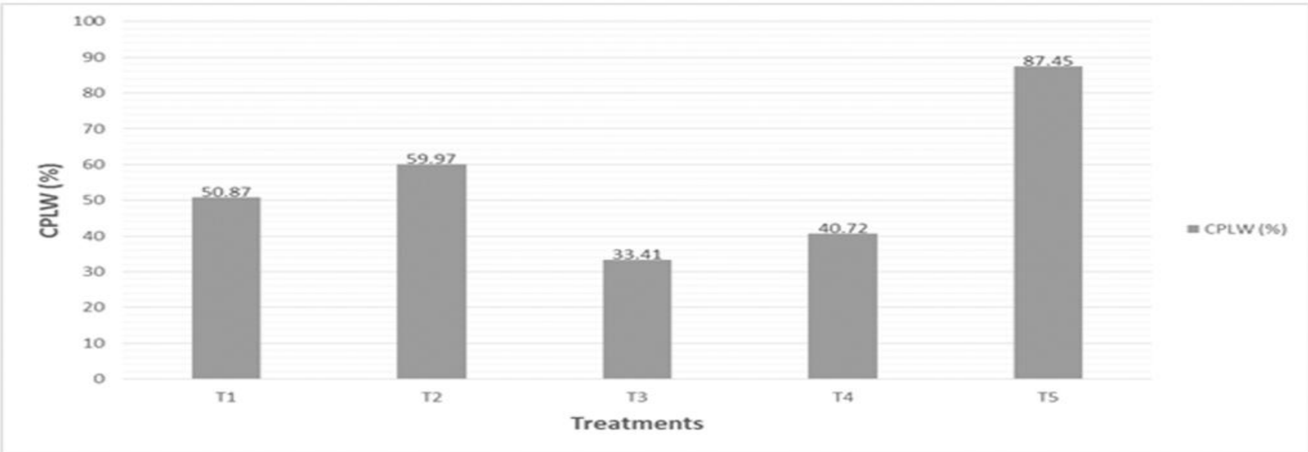

Figure 1: Effect of various holding solutions on the cumulative physiological loss in weight in *Asparagus densiflorus* cv. 'Sprengeri'

Cumulative transpirational loss of water (CTLW)

Among the various treatments, the maximum cumulative transpirational loss of water of cut foliage *Asparagus densiflorus* cv. 'Sprengeri'was observed from the foliages of treatment T_3 (27.97 g. foliage^{-1}) have sucrose 10 % + BA 25 ppm + nano silver 40 ppm + citric acid 200 ppmfollowed by T_4 (26.04 g. foliage^{-1}). The minimum cumulative transpirational loss was noticed in T_5-control (Table.1). It was noticed that the treatment which recorded higher uptake of water experienced greater transpirational loss which might be due to higher water content and higher levels of metabolic activity in the cut foliage and vice versa. These results are in conformation with the findings of Azizi *et al.* (2015) in lisianthus.

Cumulative uptake of water (CUW)

In cut foliage *Asparagus densiflorus* cv. 'Sprengeri', the cumulative uptake of water differed significantly among all the treatments. The maximum increase in cumulative uptake of water of 28.26 g. foliage^{-1} was recorded in the foliages treated with treatment T_3 (sucrose 10 % + BA 25 ppm + nanosilver 40 ppm + citric acid 200 ppm) followed by the treatment T_4 (sucrose 10 % + BA 50 ppm + nanosilver 40 ppm + citric acid 200 ppm), which recorded 26.91 g. foliage^{-1} and least

(14.42 g. foliage^{-1}) was observed in T_5-control (Table1). Similar lines of findings were obtained by Sonia Baheehmand (2014) in tuberose and Mohsen Kazemi *et al.* (2012) in cut carnation. This might be due to the application of nano silver and it acts as a bactericide which shows significant reduction of the microbial population and improved the water uptake (Koohkan *et al.*, 2014).

Table1: Effect of various holding solutions on the cumulative physiological loss in weight, Cumulative transpirational loss of water, Cumulative uptake of water and Water Balance in *Asparagus densiflorus*

Treatments	Cumulative physiological loss in weight (%)	Cumulative transpirational loss of water (g. foliage^{-1})	Cumulative uptake of water (g. foliage^{-1})	Water Balance (g.foliage^{-1})
T_1	50.87	25.61	24.80	-0.81
T_2	59.97	24.39	25.72	0.87
T_3	33.41	27.97	28.26	1.33
T_4	40.72	26.04	26.91	0.97
T_5	87.45	16.21	14.42	-1.76
SED	1.44	0.56	0.64	0.03
CD (p=0.05)	3.08	1.20	1.36	0.07

Water balance

Among all the treatments, treatment T_3 (sucrose 10 % + BA 25 ppm + nanosilver 40 ppm + citric acid 200 ppm) recorded the maximum water balance (1.33 g. foliage^{-1}), followed by T_4 (sucrose 10 % + BA 50 ppm + nanosilver 40 ppm + citric acid 200 ppm)which recorded - 0.97 g. foliage^{-1} and the minimum water balance was recorded by the T_5- control with the value of -1.76 g. foliage^{-1} (Table.1). Sucrose along with other floral preservatives improved water balance. This was attributed to the effect of sucrose act as a food source or respiratory substrate and delays the degradation of proteins and improves the water balance of cut flowers of *Eustoma grandiflorum* (Moon-Soo *et al.*, 2001). This was in accordance with the results obtained by Elgimabi and Ahmed (2009) in *Rosa hybirida.*

Table 2: Effect of various holding solutions on Optical density of vase solution, Vase life (days), Colour Index and Chlorophyll content Index in *Asparagus densiflorus*

Treatments	Optical density of vase solution	Vase life (days)	Colour Index (%)(5th day)	Chlorophyll content Index (5th day)
T_1-Sucrose 10 % + BA 25 ppm + Nanosilver 20 ppm + Citric acid 200 ppm	0.22	6.11	74.6	5.27
T_2-Sucrose 10 % + BA 50 ppm + Nanosilver20 ppm + Citric acid 200 ppm	0.28	6.82	77.9	6.35
T_3-Sucrose 10 % + BA 25 ppm + Nanosilver40 ppm + Citric acid 200 ppm	0.12	8.84	93.6	9.37
T_4-Sucrose 10 % + BA 50 ppm + Nanosilver40 ppm + Citric acid 200 ppm	0.20	7.47	88.4	7.63
T_5-Control (tap water)	0.30	5.07	64.8	2.14
SED	0.07	0.19	0.43	0.21
CD (p=0.05)	0.13	0.41	0.93	0.42

Optical density of vase solution

Among the various vase solutions tested, the least optical density (0.1278) was recorded in T_3 (sucrose 10 % + BA 25 ppm + nanosilver 40 ppm + citric acid 200 ppm) followed by T_4 which recorded the optical density of 0.2075. The maximum values of optical densities (0.3012) were observed in control (Table2). Similar line of finding was observed by Solgi *et al.* (2009) in cut gerbera cv. Dune. This may be due to the interaction of nano silver with bacterial membranes and this is considered to be the main mechanism for antimicrobial effect (Khadijid Aleksair *et al.*, 2016).

Vase life

Among all the treatments, the maximum vase life was obtained in the treatment T_3 (sucrose 10 % + BA 25 ppm + nanosilver 40 ppm + citric acid 200 ppm) with 8.84 days followed by the treatment T_4 (sucrose 10 % + BA 50 ppm + nanosilver 40 ppm + citric acid 200 ppm) which recorded a vase life of 7.47 days. The lowest vase life (5.07 days) was noticed in the T_5- control (Fig.2). Similar findings were observed by Singh *et al.* (2003) in *Nephrolepis exaltata*. This might be due to the action of nano silver which extended the vase life and attributed to the inhibition of bacterial growth in the vase solution and at the end of cut stems during the post harvest period (Qale Shakhani, 2005).

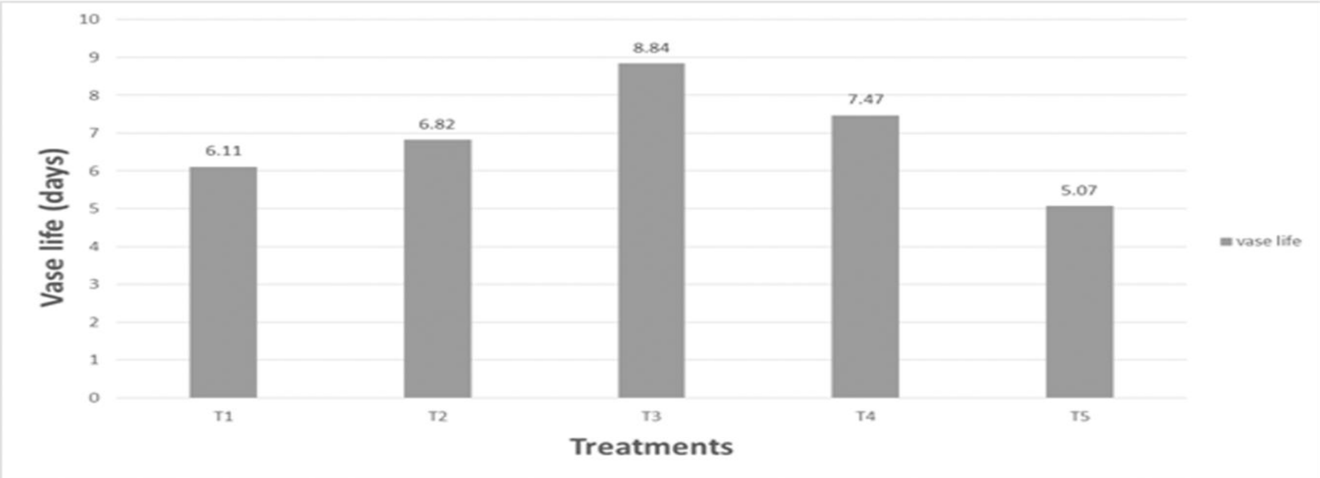

Figure 2: Effect of various holding solutions on the vase life of *Asparagus densiflorus* cv. 'Sprengeri'

Colour index

The variation exhibited by various holding solutions significantly differed with the control. The foliages treated with T_3 (sucrose 10 % + BA 25 ppm + nanosilver 40 ppm + citric acid 200 ppm) recorded the higher colour index (93.6%) on 5th day of vase life. This was followed by T_4 (sucrose 10 % + BA 50 ppm + nanosilver 40 ppm + citric acid 200 ppm) which recorded the value of 88.4%. The minimum colour index (64.8%) was recorded in T_{5-} control (Table.2). The variation in colour index may be due to the degradation of chlorophyll in the leaves, indicating the onset of senescence which was in accordance with the findings of Khalid Elhindi (2012) in cut sweet pea flowers.

Chlorophyll content index

The foliages treated with T_3 (sucrose 10 % + BA 25 ppm + nanosilver 40 ppm + citric acid 200 ppm) recorded significantly higher chlorophyll content index (9.37) on 5th day of vase life. The next best treatment was T_4 (sucrose 10 % + BA 50 ppm + nanosilver 40 ppm + citric acid 200 ppm) which recorded the value of 7.63. The least value of chlorophyll S. content index (2.14) was recorded in T_5- control (Table2). Loss of chlorophyll which occurs as a result of chloroplast degradation is also a part of the cut foliage senescence process. The onset of cut foliage senescence may be induced by various external factors such as temperature, moisture content, gases, radiation and pathogens, while internal factors related to senescence are regulated mainly by two phytoharmones, ethylene and abscisic acid. Standard preservative solution containing 2% sucrose and 200 mg dm^{-3} citrate or sulfate of hydroxyquinoline (8-HQC or 8-HQS) is often used to prolong the vase-life of *Zantedeschia aethiopica* and *Z. Elliottiana* of cut flowers. It has antibacterial properties and provides respirational substrate (Ewa *et al.*, 2004), which was in accordance with the findings of Skutnik *et al.* (2001) in *Zantedeschia aethiopica.*

It may be concluded from the results that, the holding solution with sucrose 10 % + BA 25ppm + nanosilver 40 ppm + citric acid200 ppm

(T_3) recorded minimum cumulative physiological loss in weight, maximum cumulative transpirational loss of water, maximum cumulative water uptake, least optical density, positive water balance, maximum vase life, maximum colour index and chlorophyll content index.

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