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HORTICULTURE

Effect of Certain Chemicals on Post Harvest Life of Some Cut Foliages

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ABSTRACT

Evaluations on post harvest senescence of ornamental cut foliages are deficient in contrast to cut flowers although they enact adequate prospective roles in floriculture industry. In this juncture, present investigation being employed fronds of *Asparagus plumosus*, *A. densiflorus* and *Nephrolepis exaltata* of uniform length congregated from the greenhouse of National Library, Kolkata during early hours of the day executed in the laboratory of Dept. of Horticulture, University of Calcutta under ambient temperature while GA and NAA@50 and 100ppm, $AgNO_3$@20 and 40ppm, sucrose@4 and 8% and tap water as control utilized as vase solution and pulsing treatment duo for 24hrs. Here, experimental findings revealed that $AgNO_3$@20ppm for both *A. plumosus* and *A. densiflorus* and GA@100ppm for *Nephrolepis exaltata* were ample competent to protract the vase-life of 20.66, 10.66 and 40.33 days respectively while effective vase-life after pulsing treatment of 25.66, 17.33 and 20.66 days for same aforesaid species were obtained by GA@100 and 50ppm and $AgNO_3$@20ppm. The fresh weight of all foliages remained almost unchanged upto 120hrs in both treatments. GA@100ppm as vase-solution evidently enhanced pigment intensity irrespective of entire species but upgradation of the same regarding *Nephrolepis exaltata* was obtained by $AgNO_3$@20ppm after pulsing. $AgNO_3$@20 and 40ppm and GA@50ppm facilitated also total water uptake upto 96hrs in all species but surprisingly NAA@50ppm exhibited its potency for *Nephrolepis exaltata* by 11.8ml of total water uptake. Everywhere sucrose yielded disappointed outcomes. Hence, this survey pinpointed that GA@100ppm and $AgNO_3$@20 and 40ppm as both holding solution and pulsing treatment could protract the vase-life of aforementioned irreplaceable cut foliages.

Highlights

- Investigations on protraction of longevity of cut foliages are fairly scarce.
- GA, NAA, $AgNO_3$ and sucrose exploited as holding solution and pulsing for 3 foliage species.
- GA@100 and $AgNO_3$@20 and 40ppm can be advocated for vase-life magnification.

Keywords: Foliages, holding, vase-life, pulsing, chlorophyll, protract

The present day ornamental horticulture is not merely confined for growing of few ornamental plants for pleasure or as a recreation of the rich but it has become a viable commercial enterprise (Anon, 2012). Today commercial floriculture is the most profitable agro industry in many developed (urban) and developing (suburban) countries (Abayakone *et al.,* 2010). Indian floriculture can be broadly classified into two groups while the traditional floriculture caters to the domestic market with the emphasis on the production and marketing of traditional loose flowers like marigold, jasmine etc. and the contemporary floriculture deals with cut flowers, cut foliages and potted greens (Idirisinghe *et al.,* 2013). According to Kolavalli *et al.,* 1991 India exported flowers and foliage plants worth about Rs. 84 lakhs. In recent times, the international trade of floricultural products has expanded enormously. The major portion of this trade involves cut flowers and large volumes of cut foliages and potted plants.

Cut foliage industries though included more recently in the industry but well-established by this

time since most of the important foliage plants are native to tropical regions and can be successfully grown in India and exported to European and Middle eastern markets (Wirthenson and Sedgley, 2000). The USA is the major net importer of cut greens along with most other countries in Europe. Accelerated demand of cut foliages are more likely owing to their intricate structure, attractive color, freshness of leaves or stem, substantive texture with well furnished spray not prone to wilting and long lasting in flower arrangement (Rabiza-Swider *et al*., 2004). Among numerous foliage plants, Leather leaf fern, *Rumhora adiantoformis*, *Asparagus* sp., *Podocarpus macrophyllous*, *Cordyline* sp., *Eucalyptus* sp. etc. are already entrenched their position by their suitable post harvest characteristics apart from their foliage beauty.

In late eighties, Broschat and Donselman (1987) had shown the aptitude of 57 species of tropical ornamental plants for cut foliage use. Even after detaching from the mother plant, the cut foliages can carry on all the life processes at the expense of stored food in the form of carbohydrates, proteins and fats for a few days more. As we know among the different vulnerable post harvest loss reduction biotechnology adapted in various species of flowers and foliages, use of floral preservatives have been found to influence to a great extent. It can offer at least double longevity of cut flowers and foliages duo. Nowak (1985) while working with vase life prolongation of *Asparagus sprengeri,* observed that ethrel@ 100ppm, sucrose@30gm/lit and 8-Hydroxyquinoline citrate (8-HQC)@200mg/lit lowered the vase life compared with water held, control whereas BA@ 5 or 10ppm prolonged the vase life. But on the contrary, treatment combination of 8-HQC+sucrose@ 150ppm+2.25% or 300ppm+2.25% gave notable results on the keeping quality of *Ruscus hypoglossum* and *Nephrolepis exaltata* (Nooh *et al.*, 1986). Owing to foliages 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, we had undertaken the present investigation to study the normal vase life as well as to protract the post harvest life of three lacy leaved herbaceous perennials having local demand and promising export potentiality.

MATERIALS AND METHODS

In this experiment, three ornamental foliage plants of commercial importance namely *viz. Asparagus plumosus* Baker, *A. densiflorus* (Kunth) Jessop and *Nephrolepis exaltata* (L.) Schott. were considered for this study. All these specimens belong to the family liliaceae. Both *Asparagus plumosus* and *A. densiflorus*, commonly known as Asparagus fern are ferny looking climber generally grown in greenhouse and in shady places. Concerning the first one, twigs and cladodes are arranged in a horizontal plane, triangular in outline with numerous cladodes in fascicles while latter exhibits an attractive form with dense leaved, erect plume like branches and dense needle like green foliage. *A. plumosus* is widely used by florists as a cut green as their individual leaves may send out a stem of 60cm or more long, with long stemmed rose whereas *A. densiflorus* used in different way in landscaping basically in pot than in a basket, also grown as ground cover plant in shade as well in full sun.

On the other hand, *Nephrolepis exaltata* having fronds of 50-250cm long and 6-15cm broad with alternate pinnae (the small leaflets on either side of the midrib) where each pinna is deltoid and 2-8cm long with slightly serrated edges the toughest and most widely used of all ferns. The pinnate vein patterns are also visible on its highly compound leaves. More or less uniformly matured plant materials were collected from the garden of National Library, grown in an open condition during morning hours of the day followed by transportation of them to the laboratory in moistened and wrapped condition by filter paper. After that a final recut (a slanting cut for better absorption of medium) of 2-3cm portion of leaf petiole were done under water to avoid possible air blockage of xylem vessels and kept in tap water for 2-3hrs. till they are put in respective treatment solutions. The shoots/fronds of each species were made into uniform length (*A. plumosus* [25cm], *A. densiflorus* [27.5cm], *Nephrolepis exaltata* [26.5cm]). Here to prepare treatment solutions for using as holding (vase) solution and pulsing treatment certain chemicals at specific concentrations i.e GA and NAA@50 and 100ppm, $AgNO_3$@20 and 40ppm, sucrose@4 and 8% and lastly tap water as control

were employed. Just before putting specimens in different chemical solutions, cut stems were further dressed by stripping off lower leaflets/ pinnae (where necessary) to have a clear portion for dipping in clear solution.

Before subjecting them into 100ml aqueous solutions of various chemicals containing conical flasks fresh weight of discrete cut shoots/fronds were documented. It must be ensured that the basal portion of the cut twigs certainly received a uniform dipping of 4.5cm under solutions. To avoid evaporation loss the mouth of the flask were wrapped by non permeable paper and shoots were inserted in the flask through the paper. After that, conical flasks were settled in the laboratory under ambient temperature where the range of maximum and minimum temperature was 32-34°C and 25-27°C and relative humidity and light intensity were within the range of 85-98% and 40-180lux respectively. During the course of investigation, all the materials received 8hrs of photoperiod by using 40 watt fluorescent tubes.

Here, three shoots were utilized under each treatment and each shoot represented a replication. After recording the above stated parameter finally they were dipped in chemical solutions of optimum concentration while treating these as holding (vase) solutions. Collaterally, alike number of shoots also were kept in aforesaid solutions of same concentrations for 24hrs as pulsing treatment followed by placing them in tap water till the completion of experiment.

For chlorophyll estimation being followed the protocol of Buzarbarua (2000) of controlled and treated foliages 100gm leaf tissue were taken twice i.e on the first and on the day of senescence from the replicates of each treatments. To accomplish this, culture tubes holding 80% acetone and weighed leaf tissues were refrigerated for fortnight followed by measuring the absorbance at 645 and 663nm of wave-length of the extract against solvent treated as blank in spectrophotometer (Model-166, Made by Systronics) and accordingly calculations were made using the following formula:

$$\text{Total chlorophyll (mg/ gm tissue)} = 20.2 \times (A_{645}) + 8.02 \times (A_{663}) \times V/1000 \times W$$

Where, A= Absorbance at specific wave-length

V= Final volume of chlorophyll extract in 80% acetone

W= Fresh weight of leaf taken

The experiment was conducted under laboratory of Dept. of Horticulture, Institute of Agricultural Sciences (IAS), University of Calcutta during March to August of 2015. It was carried out in Completely Randomized Design (CRD) (Panse and Sukhatme, 1985) and the data were statistically analyzed using SPSS software.

RESULTS AND DISCUSSION

According to results yielded, $AgNO_3$@ 20ppm treated foliages of both *A. plumosus* and *A. densiflorus* manifested notably extended vase life of 20.66 and 10.66 days respectively (Table 1). The other known biocide HQC was also found to be efficacious and gave a vase life of about 30 days compared with only 15 days in distilled water in *A. plumosus* (Dolci *et al.*, 1989). Concerning the first one, vase life had increased 5 days more as compare to control possibly due to the biocidal effect of $AgNO_3$ whereas for latter one minor increase was noted since 9.66 days was the effective vase life in control treatment. As ethylene antagonizing properties silver ion had been known for long years but in the form of silver nitrate it is less effective on extension of vase life, as it doesn't move rapidly through the stem (Halevy and Kofranek, 1977). But among various chemicals used, GA@50 and 100ppm and $AgNO_3$@ 20ppm only were furnished 40.33, 33.66 and 31.66 days of effective vase life respectively in contrast to normal vase life of 30.33 days in *Nephrolepis exaltata*. The fruitful consequence of GA might be due to better mobilization of metabolites (Patil *et al.*, 1996).

In *A. plumosus* higher concentration of $AgNO_3$ didn't show any beneficial impact on vase life but sucrose with higher concentration (8%) resulted an enhancement of only 3 days (Table 1). In contrast, sucrose at both concentrations (4 and 8%) were found not to influence the vase life adversely in *A. densiflorus* which was consistent with the consequence of *A. sprengeri* found by Nowak in 1985 . It was lucid from Table 1 that NAA both at 50 and 100ppm become unsuccessful to yield noteworthy output for all the species used here. The fresh weight remained almost uninterrupted in different treatments for every specimen's upto

Table 1: Effect of Different Vase-Solutions on Fresh Weight, Vase-Life, Water uptake, Transpiration loss and Water Loss/Uptake Ration of Three Utilized Foliages

Treatments	Fresh wt. of foliages (gm)	Wt. of foliages (gm) after 120hrs.	Percent (%) of chlorophyll content	Effective vase life (days)	Total water uptake up to 96hrs (ml)	Transpiration loss (ml)	Water balance	Loss/ uptake ratio	Observations
Asparagus plumosus									
Control	2.0	2.0	26.48	15.66b	2.6f	2.6	0	1.0	Yellowing, falling of cladodes
GA 50ppm	2.8	2.8	151.20	16.66b	4.4d	4.4	0	1.0	Do
GA 100ppm	3.2	3.0	397.0	15.66b	6.4b	6.0	0.4	0.93	Do
NAA 50ppm	2.8	2.6	84.23	5.66c	4.4d	4.4	0	1.0	Do
NAA 100ppm	3.0	3.0	0.51*	4.66c	4.2de	4.0	0.2	0.95	Do
$AgNO_3$ 20ppm	3.0	2.8	203.31	20.66a	3.8e	3.8	0	1.0	Do
$AgNO_3$ 40ppm	3.0	2.8	53.12	15.66b	8.6a	8.6	0	1.0	Do
Sucrose 4%	4.0	3.6	28.95	16.66b	5.6c	5.6	0	1.0	Do
Sucrose 8%	3.2	3.0	270.8	18.33ab	4.2de	4.0	0.2	0.95	Do
Asparagus densiflorus									
Control	6.2	6.0	62.28	9.66ab	12.2g	12.0	0.2	0.98	Drying of leaves, faded yellow color, leaf fall
GA 50ppm	6.4	5.0	97.57	7.66de	18.8a	19.8	-1.0	1.05	Do
GA 100ppm	4.6	4.0	109.78	6.66ef	17.8c	18.2	-0.4	1.02	Do
NAA 50ppm	5.8	5.8	4.15*	8.33cd	18.2b	18.8	-0.6	1.03	Do
NAA 100ppm	6.2	3.6	83.72	7.0e	11.2h	13.4	-2.2	1.19	Do
$AgNO_3$ 20ppm	6.8	5.2	36.60	10.66a	13f	13.0	0	1.0	Do
$AgNO_3$ 40ppm	4.6	3.8	67.91	5.66f	15.8e	16.6	-0.8	1.05	Do
Sucrose 4%	7.6	7.2	61.58	9.66ab	16.6d	16.6	0	1.0	Do
Sucrose 8%	5.0	4.4	9.14*	9.0bc	10.0i	10.6	-0.6	1.06	Do
Nephrolepis exaltata									
Control	2.6	2.6	73.26	30.33c	3.6c	3.6	0	1.0	Blackening of edges of pinna, pinna fall, tip curling
GA 50ppm	2.8	2.6	80.67	33.66b	2.6d	2.6	0	1.0	Slight tip curling, pinna fall
GA 100ppm	3.4	3.0	81.59	40.33a	2.8d	3.2	-0.4	1.14	Slight tip curling, yellowing, pinna fall
NAA 50ppm	2.0	2.2	68.54	11.66e	2.0e	1.6	0.4	0.8	Blackening of edges of pinna, tip curling
NAA 100ppm	3.2	2.8	52.14*	18.33d	4.2b	4.2	0	1.0	Tip curling, tip bending, yellowing
$AgNO_3$ 20ppm	2.8	2.8	78.37	12.33e	5.4a	5.6	-0.2	1.03	Tip curling, yellowing
$AgNO_3$ 40ppm	3.6	3.2	40.64*	31.66cd	2.8d	3.0	-0.2	1.07	Slight tip curling, pinna fall
Sucrose 4%	3.0	2.6	80.25	11.33e	1.8e	2.2	-0.4	1.2	Blackening of edges and tip of pinna
Sucrose 8%	2.8	2.6	74.94	12.66e	1.6e	2.0	-0.4	1.25	Tip curling, pinna fall

**denotes chlorophyll content of foliages decreased, N.B Similar words are not significant i.e. they are statistically at par.*

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120hrs of cutting leaves from the mother plant (data presented in Table 1), thus no relation could be drawn between vase life and fresh weight. The probable cause might be due to the nature of stalk and in most cases owing to vascular blockage fresh weight was found to be decreased as observed by other scientists (Nooh *et al.*, 1986).

In *A. densiflorus* an improvement upto 48hrs in fresh weight were achieved but gradually diminished with the increase of vase life. The trend was in close proximity with the trend noted by Barman and Rajiv (2006) in other crops. The green hues of leaves are another key visual parameter to judge its freshness. Here, experimental findings exhibited that chlorophyll content was accelerated with aid of GA@ 50 and 100ppm and $AgNO_3$@20 and 40ppm in both *A. plumosus* and *A. densiflorus* (Table 1). But along with facilitated chlorophyll content of 80.67, 81.59 and 78.37% in *Nephrolepis exaltata* by both concentrations of GA and only $AgNO_3$@20 ppm respectively, decreased percent of chlorophyll of 40.64 also was obtained by $AgNO_3$@40 ppm. Chlorophyll degradation was pointed with 100ppm of NAA whereas increased amount obtained with 50ppm in case of *A. plumosus* but exactly opposite consequences found in *A. densiflorus* and its both concentrations yielded disappointed results for *Nephrolepis exaltata*. Skutnik and Rabiza-Swider (2007) had observed ineffectiveness of commercial preservative Chrysal- RVB in *A. densiflorus* cv. 'Myriocladus' but with high chlorophyll content.

They also observed variations in effectiveness of different chemicals from species to species and between the taxa. Chlorophyll content was directly related with enhancement of vase life. It was evident from Table 1 that 270.8 and 80.25% increase in chlorophyll content by sucrose 8 and 4% were found in *A. plumosus* and *Nephrolepis exaltata* but despondent sequel had obtained in *A. densiflorus* by sucrose 4 and 8% (61.58 and 9.14%). All the treatments enhanced water uptake over control more or less in all species but transpiration loss was maximum causing water balance negligible. 8.6 and 5.4ml of total water uptake after 96hrs in *A. plumosus* and *Nephrolepis exaltata* by $AgNO_3$@40 and 20ppm respectively were found (Table 1). GA and NAA@100ppm could be contemplated as second best treatments regarding above parameter while both of these at their lower concentration revealed utmost water uptake of 18.8 and 18.2ml in *A. densiflorus*. Overall, *A. densiflorus* had responded well for cumulative water uptake (up to 6hrs) in almost all treatments. GA_3 had also been reported to increase water uptake with better maintenance of water balance and fresh weight increase which finally increase the vase life (Reddy *et al.*, 1997; Bhaskar and Rao, 1998). Increase in water uptake may be attributed to more effectiveness of the chemical in inhibiting the vascular blockage which occurs through plugging of vascular tissue by microorganism.

In case of entire specimens sucrose (4 and 8%) failed to prove their competency (Table 1). On the contrary, enhancement of water uptake by GA_3 (50, 100ppm), NAA (50, 100ppm) and sucrose (2, 4%) were pointed in rose, but ineffectiveness in vase life by GA_3 and sucrose and ineffectiveness by NAA were confirmed by Kumar and Singh (2004). They also observed inefficacy of NAA in increasing the fresh weight at different stages of vase life. Table 1 manifested that in *A. densiflorus* water loss was also higher than uptake in almost all treatments and except control most of the treatments resulted in negative water balance. Maximum reduction in water balance was observed with NAA@100ppm followed by GA@50ppm which resulted in shortened vase life of 7 and 7.66 days respectively compared to control. In case of $AgNO_3$@20ppm the vase life had increased slightly whereas uptake and loss were at par. Water balance is a major factor influencing the quality and longevity of cut flowers and foliages as recognized by many workers (Mayak *et al.*, 1974, Pal *et al.*, 2015).

In this investigation, water loss and uptake ratio was quite higher in all treatments than control thereby limiting the vase life. Yellowing of leaves and early leaf fall were documented in all treatments and specimens (Table 1) which was consistent with the sequel of 2-3 weeks vase life but with shedding of many leaves in *A. plumosus* reported by Barendse (1979). Dolci *et al.*, (1989) on the other hand had obtained vase life of this species of 15days in distilled water but also outlined the problems of falling cladodes and yellowing.

Firstly, it should be disclosed that the impact of pulsing treatments for 24hrs with assist of same chemicals at their alike concentration were accomplished only in case of *A. plumosus* and *Nephrolepis exaltata* not in *A. densiflorus* since it

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Table 2: Effect of Different Pulsing Treatments on Fresh Weight, Vase-Life, Water uptake, Transpiration loss and Water Loss/Uptake Ration of Three Utilized Foliages

Treatments	Fresh wt. of foliages (gm)	Wt. of foliages (gm) after 120hrs.	Percent (%) of chlorophyll content	Effective vase life (days)	Total water uptake up to 96hrs (ml)	Transpiration loss (ml)	Water balance	Loss/ uptake ratio	Observations
				Asparagus plumosus					
Control	4.8	4.6	3.21*	15.66d	7.2a	7.0	0.2	0.97	Yellowing, falling of cladodes
GA 50ppm	3.8	3.0	77.07	19.66b	6.4b	7.2	-0.8	1.12	Do
GA 100ppm	3.6	3.2	221.12	25.66a	4.2e	4.0	0.2	0.95	Do
NAA 50ppm	3.6	3.4	59.21	6.33e	4.8d	4.6	0.2	0.96	Do
NAA 100ppm	4.0	3.8	25.87	5.33e	5.4c	5.4	0	1.0	Do
$AgNO_3$ 20ppm	4.0	3.6	35.43	17.66c	4.6de	4.2	0.4	0.91	Do
$AgNO_3$ 40ppm	3.6	3.2	29.16	5.66e	7.4a	7.6	-0.2	1.02	Do
Sucrose 4%	4.0	3.6	41.12	16.66cd	4.2e	4.0	0.2	0.95	Do
Sucrose 8%	4.0	3.6	56.66	16.66cd	3.6f	4.0	-0.4	1.11	Do
				Nephrolepis exaltata					
Control	3.8	3.2	82.35	18.66bc	7.4f	7.8	-0.4	1.05	Blackening of tips of fronds, tip curling
GA 50ppm	4.2	3.8	82.76	17.33cd	8.4de	8.2	0.2	0.98	Blackening of tip, pinna fall
GA 100ppm	4.0	3.4	83.24	13.66e	8.6cd	8.8	-0.2	1.02	Blackening of edges of pinna, pinna fall
NAA 50ppm	5.2	4.4	54.28*	15.66d	11.8a	12	-0.2	1.01	Edge blackening of pinna, tip curling, pinna fall
NAA 100ppm	5.0	3.3	29.46*	12.33e	10.6b	11	-0.14	1.03	Tip blackening, profuse pinna fall, yellowing
$AgNO_3$ 20ppm	4.2	4.0	84.51	20.66a	8.8c	8.6	0.2	0.98	Slight tip curling and slight tip blacjening
$AgNO_3$ 40ppm	4.6	4.2	12.17*	16.66d	10.6b	10.2	0.4	0.96	Tip curling and blackening
Sucrose 4%	5.0	4.4	74.53*	19.33ab	8.2e	8.4	-0.2	1.02	Tip blackening and bending, pinna fall
Sucrose 8%	3.6	3.0	61.01*	17.33cd	7.4f	7.2	0.2	0.97	Blackening of edges of pinna,, pinna fall

**denotes chlorophyll content of foliages decreased, N.B Similar words are not significant i.e. they are statistically at par.*

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lies under same genus named *Asparagus*. It was evident from Table 2 that GA @ 100 ppm and $AgNO_3$@20ppm provided maximum vase life in *A. plumosus* and *Nephrolepis exaltata* of 25.66 and 20.66 days respectively as compare to control. Earlier studies in other fern *Adiantum raddianum* also confirmed the efficacy of $AgNO_3$ in delaying the wilting, common in fern due to vascular blockage of the basal end of the petiole (Doorn *et al.*, 1991).

But $AgNO_3$@40ppm divulged unproductive result of only 5.66 days of vase life as compare to 15.66 days of vase life in control in *A. plumosus*. Similar findings were also achieved by Singh *et al.*, (2004) in foliage species of *Blechnum gibbum* (a fern) where fruitless output of $AgNO_3$ as pulsing treatments were found but when combined with sucrose, they significantly increased vase life of fronds. Fujino and Reid (1983) had also obtained a little effect of $AgNO_3$ with specific concentration in Maiden hair fern. GA@50 and 100ppm both could be appraised for *A. plumosus* as second best pulsing treatment but patently not in case of *Nephrolepis exaltata* as the vase life were shortened significantly after dipping treatment by GA (Table 2). Sucrose at their both upper and lower concentration showed inconsequential impact on vase life extension of both these species (Table 2). Nowak in 1985 while evaluating the different chemical treatments for vase life prolongation of *Asparagus sprengeri* observed the beneficial effect of BA (N^6-benzyladenine) at 5 or 10 ppm whereas ethylene gas at 100 or 250 ppm, ethrel (ethephon) at 100 ppm, sucrose at 30g/litre or 8-HQC at 200mg/lit reduced the vase life. NAA@ 50 and 100 ppm duo failed to manifest any noteworthy pulsing effect on them evinced from Table 2.

Here, fresh weight was documented upto 120hrs (upto 5^{th} day of vase life) as presented in Table 2 in both species. There were no major changes due to different pulsing treatments. However, slight reduction was recorded after 4^{th} day onwards. Sivasamy and Bhattacharjee (2000) also reported that fresh weight generally increased in first few days; hereafter it decreased gradually till senescence. Chlorophyll content had been found to increase significantly irrespective of pulsing treatments as compare to control where only 3.21% chlorophyll was found in fronds after 120hrs but consequential result obtained by GA@100ppm of 221.12% chlorophyll content increase in *A. plumosus*. This treatment also extended the vase life, establishing a relation. It was interesting to note in *Nephrolepis exaltata* that the entire pulsing treatments had an adverse effect on the chlorophyll content except $AgNO_3$@20ppm and control where it was noted to be increased (Table 2). Regarding the effect on water uptake of various pulsing treatments were found not to influence much in both species. For *A. plumosus* slightly decreased water uptake over control was pointed in most cases but $AgNO_3$@40ppm found quite better among all while NAA@50 and 100ppm duo and $AgNO_3$@40ppm also exhibited 11.8, 10.6 and 10.6 ml of total water uptake after 96hrs in *Nephrolepis exaltata* which was utmost even than control. In this species transpiration loss was also high in all the treatments including control causing negative or zero water balance.

Thus no relation could be established between water uptake and vase life. Stamps *et al.*, (1989) also had found no correlation between water uptake and vase life in leather leaf fern fronds. In *A. plumosus* total water uptake by GA@100ppm was lower than the control. However, transpiration loss was less than the water uptake causing a positive water balance ultimately extended vase life (Table 2). $AgNO_3$@20ppm had also caused positive water balance and magnified the vase life also. Sucrose 4% had resulted positive water balance while sucrose 8% yielded negative water balance but both the treatments have slightly increased the vase life (Table 2). So, it was difficult from this result to draw a sharp satisfactory relation between water balance and vase life. Different external manifestations were also noted during the vase life studies of these two. In both case, pinnae fall, yellowing and curling of tips were observed specially associated with reduced vase life.

CONCLUSION

Increasing vase life is the key issue in the post harvest management of cut foliages. It appears that chemicals used for enhancing vase life, improve the water uptake of cut foliages by reducing the vascular blockage and ultimately improving the vase life (Poole *et al.*, 1984). A number of chemicals have positive effect in delaying senescence (as evident from reports of many workers). Our survey have pinpointed GA@100ppm and $AgNO_3$@20 and

40ppm out of the nine treatments though some other chemicals were also found to be more or less effective were extraordinary for all these three foliages as holding treatments. Increased vase life of GA treated may be owing to better mobilization of metabolites. A biocide inhibits microbial growth in vase water and improves water absorption and therefore it may be a possible reason behind the better vase life of $AgNO_3$ treated plants. Fujino and Reid in 1983 reported fivefold increased vase life by using 25mg/litre Ag^+ ions in *Adiantum raddianum* whereas other biocides such as 8-HQC either alone or with NaOCl had a little effect. Sucrose has also been found to have a positive effect in the vase life of certain species. Possibly sucrose as a vase solution or pulsing solution was the main carbohydrate source which decreased the water potential and thus improved the water uptake and fresh weight of the foliages. It can be inferred that in *A. plumosus*, pulsing of shoots with chemicals was found to be more effective than the holding treatments but not in *Nephrolepis exaltata*. So there is a possibility or scope of future research for enhancement of vase life of cut foliages by using sucrose in combination with a biocide *viz.* $AgNO_3$@20 and 40ppm.

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