



Standardization of glycerine preservation for ornamental foliage of different species suitable for value addition

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ABSTRACT

Studies were carried out in the Division of Floriculture and Landscaping, ICAR-IARI New Delhi during 2016-17 to standardize the glycerine preservation technology for foliage of silver oak, cordyline, asparagus and fern under laboratory conditions. The foliage was subjected for glycerinization by immersing and uptake methods with different combinations of glycerine and water. Observations were made for moisture loss (%), time taken for drying and sensory parameters like texture, shape retention, brittleness, overall acceptance of the cut foliages etc. and were subjected to analysis of variance. In case of silver oak treating the foliage with 1:3 ratio of glycerine and water found better for minimum moisture loss (%) while 1:2 ratio of glycerine and water was suitable for minimum days taken for drying in both the methods i.e. full dip and uptake and for most the qualitative parameters 1:3 ratio of glycerine and water were recorded better score in silver oak. For asparagus 1:3 ratio of glycerine and water with full dip method found most suitable for quantitative and the qualitative parameters were also found best in 1:3 ratio of glycerine and water but in both the methods i.e. full dip and uptake. In case of cordyline 1:3 ratio of glycerine and water found suitable for minimum moisture loss (%) and uptake method with 1:3 ratio of glycerine and water recorded minimum days taken for drying. Sensory parameters revealed similar finding as quantitative parameters. Treating the foliage of fern in 1:3 ratio of glycerine and water with full dip method were found better for quantitative parameters studied as well as for most of the qualitative parameters also.

Key words: Asparagus, Cordyline, Fern, Glycerine, Preservation, Silver oak

Floriculture is a booming industry in the world today. Cut-flowers, flower buds, fresh, dried, dyed, bleached, foliage, branches and other parts of trees, shrubs, bushes and different types of grasses are suitable material for bouquets, decoration purpose and value addition. Drying and preserving foliage and flowers is a form of artistic way of expressing feelings since ancient times (Lourdusamy *et al.* 2001). Beauty and everlasting value of ornamentals can be preserved by applying different dehydration techniques which can be cherished for years without losing their appearance and decorative value. Dried flowers are exported mainly from Tamil Nadu and West Bengal, with the later accounting for around 70 per cent of the dried flower exports from the country (Sumana 2011). Dried and preserved flower products and botanicals have tremendous potential as they are cheaper, easily available, eco-friendly and biodegradable (Bhattacharjee and De 2003).

Normally the flowers and foliage were dried by different methods like air, desiccant, oven, freeze and microwave

drying. All the methods of drying are most suitable for flowers but the dried foliage tends to be brittle product with degraded green colour. Glycerine drying is most suitable for foliage preservation due to its osmotic nature (Harten 2002), therefore, the foliage thus preserved and retain flexibility, shape and texture (White *et al.* 2007) and can be used widely in preparation of many value added products. Finding out an appropriate concentration of glycerine for better quality of foliage dehydration is important to support the entrepreneurs in the competitive global flower market. Therefore, the present investigation was carried out to determine the effect of different methods, and concentrations of glycerine on preservation of foliage for value addition.

MATERIALS AND METHODS

The present studies were carried out in the laboratory of Division of Floriculture and Landscaping, ICAR-IARI, New Delhi during 2016-17 using foliages of four plant species namely; silver oak (*Grevillea robusta*), Boston fern (*Nephrolepis exaltata*), cordyline (*Cordyline fruticosa*) and asparagus (*Asparagus meyeri*). The experiment consisted of treatment combinations replicated thrice having five specimens per replication. The treatments consisted of two methods and five concentrations of glycerine and were

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compared with control. The methods used for preserving foliage includes keeping the stems in glycerine solution, i.e. uptake method (M₁) or immersing the complete foliage in glycerine solution, i.e. full dip method (M₂). Following observation, viz. percentage of moisture loss, days taken for drying (days taken when change in colour of the foliage) and quality parameters like retention of shape, texture, colour, scale of brittleness and overall acceptability were assessed by means of sensory evaluation through scoring on five point scale, i.e. excellent (8-9), very good (6-8), good (4-6), moderate (2-4) and poor (0-2). The data were subjected to FCRD design by using OPSTAT statistical software.

Details of treatments are as follows: T₁ M₁: Control (air drying), T₁ M₂: Control (air drying), T₂ M₁: 1:1 Glycerine and water (Uptake method), T₂ M₂: 1:1 Glycerine and water (Full dip method), T₃ M₁: 1:2 Glycerine and water (Uptake method), T₃ M₂: 1:2 Glycerine and water (Full dip method), T₄ M₁: 2:1 Glycerine and water (Uptake method), T₄ M₂: 2:1 Glycerine and water (Full dip method), T₅ M₁: 1:3 Glycerine and water (Uptake method), T₅ M₂: 1:3 Glycerine and water (Full dip method), T₆ M₁: 3:1 Glycerine and water (Uptake method), T₆ M₂: 3:1 Glycerine and water (Full dip method).

RESULTS AND DISCUSSION

Data pertaining to percentage of moisture loss and time taken for drying of foliage during glycerinization by two different methods (immersed/full dip and uptake) with different concentrations was compared with control and results are presented in Table 1 and 2 and Fig 1 to 4.

Moisture loss (%)

It is evident from the data in Table 1 that the effect of treatments was found to be significant, whereas the effect of method and interaction was found to be non-significant w.r.t moisture loss in silver oak and cordyline. It was observed that minimum moisture loss in silver oak (15.07%) and cordyline

(18.02%) was recorded in treatment consisting of 1 part glycerine and 3 parts of water (T₅) and was statistically at par with T₃ in both the species, however maximum moisture loss was observed under control (air drying).

In case of fern and asparagus the effect of method of drying, treatments and interaction was found to be significant with respect to moisture loss (Table 1). Minimum moisture loss in fern (35.07%) and asparagus (25.91%) was recorded under full dip method (M₂) while maximum moisture loss was observed in uptake method (M₁).

Among concentrations of glycerin it was observed that minimum weight loss in fern leaves (21.42%) and asparagus (11.53 %) was recorded with 1:3 ratio of glycerin : water (T₅) and was at par with T₃. However maximum moisture loss (72.84% in ferns and asparagus 75.12%) was observed in leaves dried under air (control T₁).

The interaction data shows that the treatment combination T₅M₂ resulted in minimum moisture loss in fern leaves (20.29%) and asparagus (8.29%) and was at par with T₃M₂ and T₅M₁ in case of ferns. The maximum moisture loss (72.84% in fern and 75.12 % in asparagus) was observed under treatment combinations T₁M₁ and T₁M₂.

Similar results were reported in podocarpus, leather leaf fern, baby eucalyptus and silver dollar (Vishnupriya and Jawaharlal 2014). This may be attributed to the reason that glycerin replaces the moisture by capillary action and has antifreeze property (White *et al.* 2007), moreover, glycerin having three OH groups so it has strong affinity towards water (Visalakshi 2013). These findings are in accordance with the earlier reports in eucalyptus and ivy (Anonymous 2004), in emu bush (*Podocarpus* sp.) and umbrella fern (*Sticherus* sp.) (Paul and Joyce 2005), in magnolia and palmetto (White *et al.* 2007), in camellia, maiden hair fern (Deepthi and Santhosh 2008); in camellia, silver oak and thuja (Chintu 2010) in podocarpus and pteridium (Anita 2010).

Table 1 Effect of treatments and methods of glycerinization on moisture loss (%) of different foliage species

Treatment	Silver oak			Asparagus			Cordyline			Fern		
	Uptake (M ₁)	Full dip (M ₂)	Mean	Uptake (M ₁)	Full dip (M ₂)	Mean	Uptake (M ₁)	Full dip (M ₂)	Mean	Uptake (M ₁)	Full dip (M ₂)	Mean
T ₁	55.71	55.71	55.71	75.12	75.12	75.12	53.93	53.93	53.93	72.84	72.84	72.84
T ₂	30.77	30.53	30.65	29.26	16.39	22.82	26.07	24.98	25.53	29.83	27.32	28.57
T ₃	19.19	17.72	19.74	21.89	10.12	16.00	25.74	19.58	22.66	26.29	23.66	24.97
T ₄	33.59	32.96	33.27	41.58	18.48	30.03	35.67	44.17	39.92	32.51	30.52	31.51
T ₅	21.75	10.95	15.07	14.76	8.29	11.53	20.59	15.46	18.02	22.55	20.29	21.42
T ₆	51.90	50.7	51.30	53.56	27.03	40.29	41.02	48.97	45.00	56.88	35.79	46.34
Mean	35.49	33.10		39.36	25.91		33.84	34.51		40.15	35.07	
CD (P= 0. 05)												
Treatments (T)		5.53			4.74			6.76			4.79	
Methods (M)		NS			2.74			NS			2.76	
Interaction (T×M)		NS			6.71			NS			6.78	

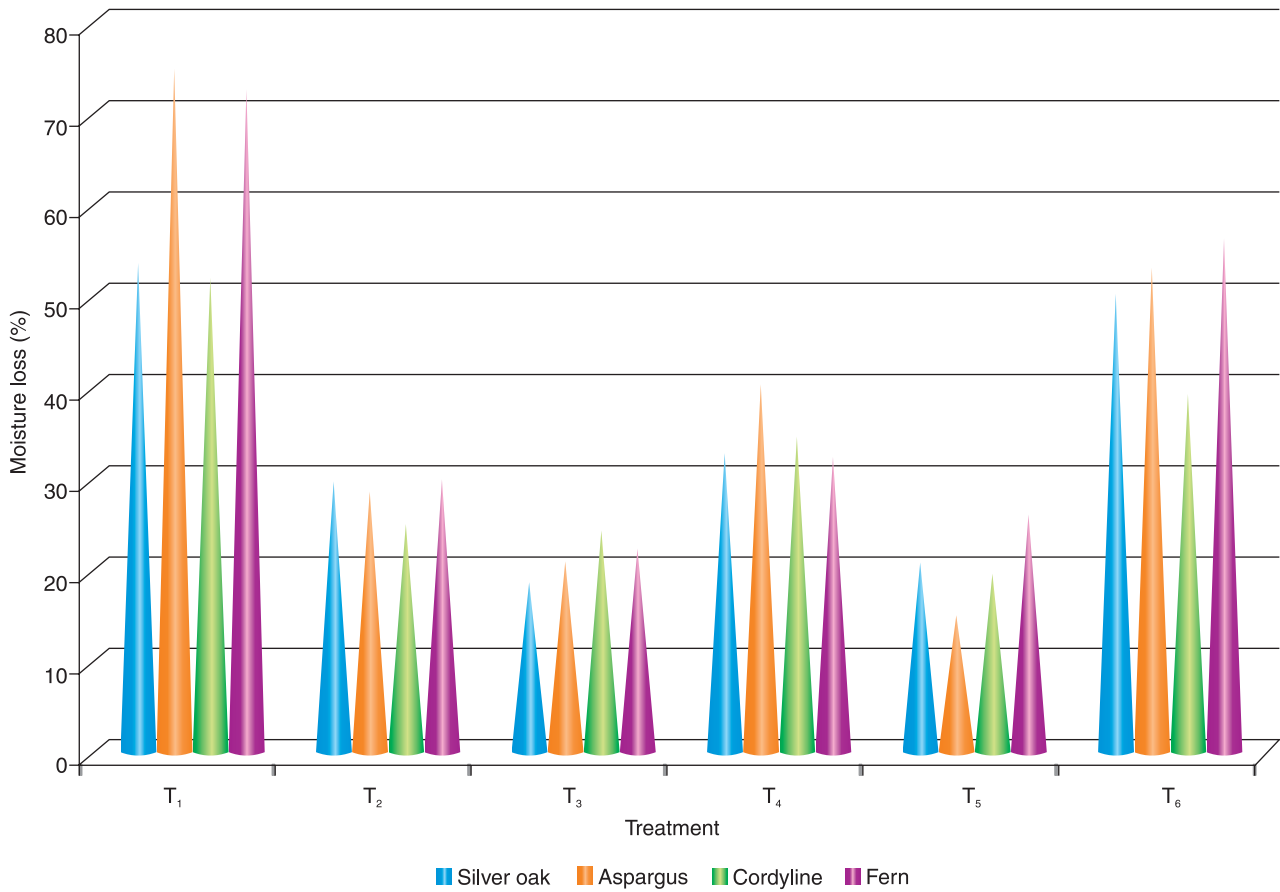


Fig 1 Moisture loss (%) in foliage of silver oak, asparagus, cordyline and fern leaf by uptake method of preservation.

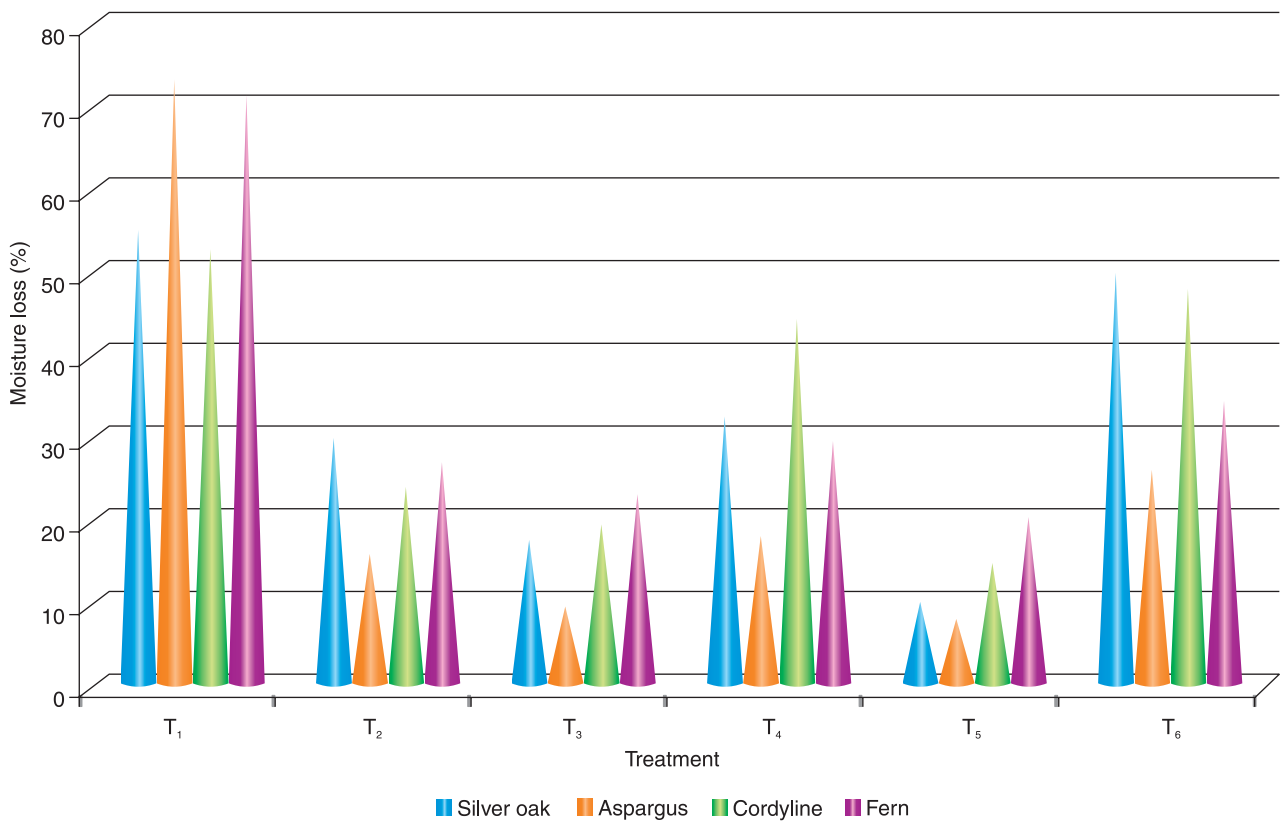


Fig 2 Moisture loss (%) in foliage of silver oak, asparagus, cordyline and fern leaf by immersed (full dip) method of preservation.

Days taken for drying

It is clear from the data presented in Table 2 that the effect of method of drying, treatments and interaction was found to be significant with respect to days taken for drying for all the foliage species. The drying time taken for preservation of different foliage plant varied from 2.50 days to 12.17 days in uptake method. The average minimum number of days taken for drying of silver oak (2.50), and cordyline (6.22) were observed in uptake method (M_1), whereas for fern and asparagus minimum number of days for drying (5.94 and 5.17 respectively) were recorded in full dip method (M_2).

Among concentrations of glycerine it was observed that minimum days taken for drying in silver oak (1.67) was recorded with 1:2 ratio of glycerin : water (T_3) and was at par with T_5 . However maximum number of days taken for drying (3.83) were observed in T_6 (3 part glycerine:1 part water).

Perusal of data in Table 2 shows that drying the foliage of silver oak in 1:2 ratio of glycerine: water through full dip or uptake method (T_3M_1 and T_3M_2) resulted in minimum days for drying (1.67) and was at par with T_4M_1 and T_5M_1 . Maximum number of days for drying (4.67) were observed in treatment combination T_6M_2 .

In case of ferns minimum duration for drying (7.00 days) was observed in treatment T_3 and T_4 and was at par with T_2 and T_6 (Table 2). The interaction data shows that the foliage of ferns took minimum days for drying (3.33) with 1:3 glycerine and water concentration in full dip method (T_5M_2) and was at par with T_3M_2 and T_4M_2 . The maximum days taken for drying (15.33) were observed under treatment combinations T_1M_1 and T_1M_2 .

In case of cordyline, minimum duration for drying (5.00 days) was observed in treatment T_4 and was at par with T_3 and T_5 while maximum days for drying (8.67) were observed under control (T_1). The interaction data shows that the cordyline took minimum days for drying (4.33) with

1:3 glycerine and water concentration in uptake method (T_5M_1) and was at par with T_3M_2 , T_4M_1 , T_4M_2 and T_6M_1 . The maximum number of days were taken for drying (8.67) under treatment combinations T_1M_1 and T_1M_2 .

Minimum duration for drying in asparagus (4.50 days) was observed in treatment T_5 while maximum duration for drying (8.67) were observed under control (T_1). The interaction data shows that the asparagus took minimum days for drying (4.00) with 1:2, 1:3 glycerine and water concentration in full dip method (T_3M_2 and T_5M_2) and was at par with T_4M_2 . The maximum days taken for drying (8.67) was observed under treatment combinations T_1M_1 and T_1M_2 . Similar to the above findings Paul and Joyce (2005) reported that the time varied according to the size and density of the plant materials.

Effect of glycerine preservation on qualitative attributes: Significant differences among the different treatments on the quality traits were obtained for the leaves of silver oak, asparagus, cordyline and fern as presented in Table 3 to 6.

Silver oak

The perusal of data in Table 3 shows that treating the foliage of silver oak with 1:2 (T_3) ratio of glycerine and water resulted in maximum score with respect to leaf texture (8.16), whereas the effect of method and interaction was found to be non-significant. In case of qualitative parameter shape retention the maximum score was observed in T_5 treatment (8.33) and among the methods the maximum score (6.94) was recorded in uptake method (M_1). The interaction data shows non-significant results among treatment and methods of drying. In case of overall acceptability the maximum score (7.99) was found in T_5 treatment and was statistically at par with T_3 treatment (7.83). The interaction data shows that the treatment combination T_5M_2 resulted in maximum score for overall acceptance (8.66). The minimum score for overall acceptance was observed under treatment combination T_1M_1 and T_1M_2 . Among all the treatments no brittleness was

Table 2 Effect of treatment and methods of glycerinization on days taken for drying of different foliage species

Treatment	Silver oak			Asparagus			Cordyline			Fern		
	Uptake (M_1)	Full dip (M_2)	Mean	Uptake (M_1)	Full dip (M_2)	Mean	Uptake (M_1)	Full dip (M_2)	Mean	Uptake (M_1)	Full dip (M_2)	Mean
T_1	3.33	3.33	3.33	8.67	8.67	8.67	8.67	8.67	8.67	15.33	15.33	15.33
T_2	2.67	4.33	3.50	7.33	4.33	5.83	8.00	8.33	8.17	13.00	4.33	8.17
T_3	1.67	1.67	1.67	7.00	4.00	5.50	6.00	5.67	5.83	10.33	3.67	7.00
T_4	2.33	4.00	3.17	7.67	4.33	6.00	5.00	5.00	5.00	10.33	3.67	7.00
T_5	2.00	2.67	2.33	5.00	4.00	4.50	4.33	6.33	5.33	13.33	3.33	8.83
T_6	3.00	4.67	3.83	8.33	5.67	7.00	5.33	8.33	6.83	10.67	5.33	8.00
Mean	2.50	3.44		7.33	5.17		6.22	7.06		12.17	5.94	
<i>CD (P=0.05)</i>												
Treatments (T)		0.69			0.89			0.96			1.23	
Methods (M)		0.40			0.52			0.55			0.71	
Interaction (T×M)		0.98			1.26			1.36			1.74	

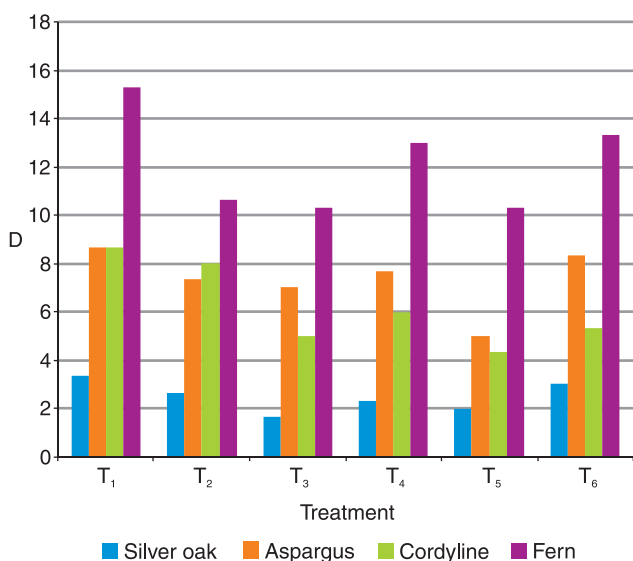


Fig 3 Time taken for drying of silver oak, asparagus, cordyline and fern leaf in uptake method of preservation.

observed in both methods except control. The retention of colour was recorded as per Royal Horticultural Colour Chart by panel of judges. Colour of leaves gradually changed after employing different treatments. In silver oak the colour of foliage observed was fern green in uptake method in all concentration while in full dip method colour observed was ivy green to partial green according to treatments but in control it was willow green. Similar results were reported by Dombewarisa *et al.* (2016) in silver oak @20% glycerin

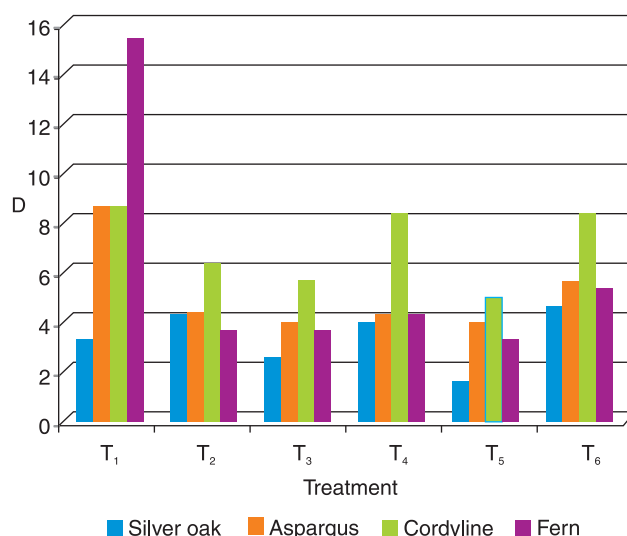


Fig 4 Time taken for drying of silver oak, asparagus cordyline and fern leaf in immersed method of preservation.

concentration with respect to leaf texture, shape retention and overall acceptability with high flexibility and glossiness.

Asparagus

The maximum score (8.66) for leaf texture, shape retention and overall acceptability was observed in treatment T₅ (1:3 glycerin and water solution), whereas among the methods of drying it was found to be non-significant in all three qualitative parameters. The interaction data shows

Table 3 Effect of different treatments and methods of glycerinization on qualitative parameters of silver oak

Treatment	Leaf texture score		Mean	Shape retention score		Mean	Overall acceptance score		Mean	Brittleness (Yes/No)		Colour code (RHS colour chart)		
	Method			Method			Method			Method		Method		
	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)		
T ₁	5.33	5.33	5.33	4.33	4.33	4.33	4.66	4.66	4.66	Yes	Yes	W.G. 00862	W.G. 00862	
T ₂	7.33	7	7.16	8	6.66	7.33	7.33	6.66	6.99	No	No	F. G. 0862	I. G. 0001060	
T ₃	8.66	7.66	8.16	8.66	7.33	7.99	8.33	7.33	7.83	No	No	F. G. 0862	I. G. 0001060	
T ₄	7.33	5.66	6.49	7.33	5.66	6.49	7	5.66	6.33	No	No	F. G. 0862/2	P. G. 00962	
T ₅	7.66	8.33	7.99	8	8.66	8.33	7.33	8.66	7.99	No	No	F. G. 0862/1	I. G. 0001060	
T ₆	5.33	5.33	5.33	5.33	5	5.16	5.66	5	5.33	Yes	No	F G 0862	P G 00962	
Mean	6.94	6.55		6.94	6.27		6.72	6.33						
CD (P=0.05)														
(T)	1.01				0.91		0.79							
(M)	NS				0.52		NS							
(T×M)	NS				NS		1.13							

FG- Fern green, IG- Ivy green, PG- Partial green

Table 4 Effect of different treatments and methods of glycerinization on qualitative parameters of asparagus

Treatment	Leaf texture score		Mean	Shape retention score		Mean	Over all acceptance Score		Mean	Brittleness (Yes/No)		Colour code (RHS colour chart)	
	Method			Method			Method			Method		Method	
	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	
	T ₁	5	5	5	4.66	4.66	4.66	5	5	5	Yes	Yes	S. G 000861
T ₂	7	7.33	7.16	7.33	7.33	7.33	7.33	7	7.16	No	No	I. G. 0001060/2	F. G. 0862/1
T ₃	8	7.66	7.83	8.66	7.66	8.16	8.66	7.66	8.16	No	No	I. G. 0001060	F. G. 0862/1
T ₄	6.33	6.33	6.33	6.33	6.33	6.33	5.33	6.33	5.83	No	No	I. G. 0001060	F. G. 0862
T ₅	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66	No	No	I. G. 0001060	F. G. 0862
T ₆	5.66	4.33	4.99	6.33	4	5.16	4.66	4	4.33	No	No	I. G. 0001060/3	Sp. G. 0960/3
Mean	6.78	6.55		7.00	6.44		6.61	6.44					
<i>CD(P=0.05)</i>													
(T)		1.01			1.01				0.89				
(M)		NS			NS				NS				
(T×M)		1.44			1.44				1.26				

FG- Fern green, IG- Ivy green, SG- Sage green

that the treatment combination T₅ M₁ and T₅ M₂ resulted maximum score (8.66) for leaf texture similar results were found in case of shape retention (8.66) and overall acceptance (8.66) in both the treatment combination (T₅ M₁ and T₅ M₂) also followed by T₃M₁ treatment combination. Zero brittleness was found in foliage preserved by glycerin except in control (air drying-T₁). The colour according to RHS chart of asparagus leaf after drying observed Ivy green in all treatments but in full dip method it was observed as fern green except in control where it gives sage green colour.

Cordyline

The data for qualitative traits for cordyline was analysed and presented in Table 5. It is clear from data that the leaf texture scored (8.66) maximum point in T₅ (1:3 glycerin: water). In case of methods of drying the maximum leaf texture score (6.66) was observed in case of full dip method (M₂). The interaction data shows that the treatment combinations T₅M₁ and T₅M₂ resulted in maximum leaf texture score (8.66). The minimum score (4.33) was observed under treatment combinations T₁M₁ and T₁M₂. In case of qualitative parameter shape retention the maximum score (8.83) was observed in T₅ treatment, whereas the effect of method and interaction was found to be non-significant. It is clear from the data that the overall acceptance scored (8.83) also maximum in T₅ (1:3 glycerin: water) while in case of methods of drying the full dip method (M₂) scored highest (6.89). The interaction was found to be non-significant w.r.t overall acceptance qualitative parameter. Brittleness was not found in any of the treatments except in control (T₁). The

colour of cordyline leaf changed after drying and showed variation as per RHS chart. The colour of leaf after drying was recorded as willow green in treatments T₃, T₂ and T₆ and fern green in T₅ and T₆ in uptake method but in full dip method it varied from willow green to partially green and fern green under control.

Fern

The data pertaining to qualitative parameters of ferns have been presented in Table 6. It is evident from data that among treatments or ratio of glycerine and water for glycerinization maximum score for leaf texture (8.16) was found in treatment T₃ and T₅ and minimum score (5.33) was found in treatment T₁ (air drying), whereas in case of method of glycerinization the maximum score (7.38) observed in full dip method (M₂). The interaction data shows that the treatment combination of T₅M₂ scored (8.66) maximum for leaf texture. In case of shape retention it is clear from the data that the treatment T₃ scored (8.33) maximum and was statistically at par with treatment T₅. Among the methods of drying the maximum score (7.44) was found in case of full dip method (M₂). The interaction was found to be non significant w.r.t shape retention score. The overall acceptance scored (8.33) maximum for treatment T₃ and if we compared the method of drying it was found maximum in case of full dip method (M₂). The interaction data shows that the treatment combination T₅M₂ resulted maximum score (8.66) for overall acceptance. This might be due to the effect of glycerin which preserves the foliage by retaining the shape of leaves through softening of stem which leads

Table 5 Effect of different treatments and methods of glycerinization on qualitative parameters of cordyline

Treatment	Leaf texture score		Mean	Shape retention score		Mean	Overall acceptance Score		Mean	Brittleness (Yes/No)		Colour code (RHS colour chart)	
	Method			Method			Method			Method		Method	
	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	
	T ₁	4.33	4.33	4.33	5.66	5.66	5.66	5.33	5.33	5.33	Yes	Yes	FG
T ₂	6	6.66	6.33	6.66	7	6.83	6.33	6.66	6.49	No	No	WG	PG 00962
T ₃	6.66	7.66	7.16	7.33	8.33	7.83	6.33	8.33	7.33	No	No	WG	PG 00962
T ₄	5	6.33	5.66	5.66	6	5.83	5.33	6.33	5.83	No	No	FG	WG 00862
T ₅	8.66	8.66	8.66	8.66	9	8.83	8.66	9	8.83	No	No	FG	PG 00962
T ₆	5	6.33	5.66	5.33	6.33	5.83	5	5.66	5.33	No	No	WG	WG 00862
Mean	5.94	6.66		6.55	7.05		6.16	6.89					
<i>CD (P=0.05)</i>													
(T)		0.97			1.14			1.11					
(M)		0.56			NS			0.64					
(T×M)		1.38			NS			NS					

FG- Fern green, PG- Partial green, WG- Willow green

Table 6 Effect of different treatments and methods of glycerinization on qualitative parameters of fern

Treatment	Leaf texture score		Mean	Shape retention score		Mean	Over all acceptance score		Mean	Brittleness (Yes/No)		Colour code (RHS colour chart)	
	Method			Method			Method			Method		Method	
	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	Uptake (M ₁)	Full dip (M ₂)	
	T ₁	5.333	5.333	5.333	6	6	6	5.667	5.333	5.5	Yes	Yes	SG
T ₂	6	8	7	5.667	8	6.833	6	8	7	No	No	WG	FG
T ₃	8.333	8	8.167	8.333	8.333	8.333	8.333	8.333	8.333	No	No	WG	FG
T ₄	6	7.667	6.833	6.333	7.333	6.833	5.333	7.667	6.5	No	No	WG	FG
T ₅	7.667	8.667	8.167	8	8.333	8.167	7.667	8.667	8.167	No	No	WG	FG 0862
T ₆	7.333	6.667	7	6.667	6.667	6.667	6.667	6.667	6.667	No	No	SG	FG 0862/2
Mean	6.778	7.389		6.833	7.444		6.611	7.444					
<i>CD (P=0.05)</i>													
Factor(T)		0.89			0.95			0.79					
Factor(M)		0.51			0.55			0.46					
Factor (T × M)		1.26			NS			1.13					

SG- Sage green, FG- Fern green, WG- Willow green

pliable and long lasting foliage. Brittleness was not found in any of the treatments except in control (T_1) in air dried leaves. This might be due to the fact that optimum usage of glycerin would lead to complete preservation, whereas too much use of glycerin leads to cohesion tension in the plant which could not be strong enough to uptake a very viscous fluid (Le 1997). The colour of fern leaf changed after drying and showed variation as per RHS chart. The colour of leaf after drying was recorded as willow green in treatments T_2 , T_3 , T_4 and T_5 and sage green in T_1 and T_6 in uptake method and fern green in all the treatments in full dip method except in control where it exhibited sage green colour.

Conclusion

There are several benefits of using glycerine to preserve flowers. Petals and foliage preserved with this method remain supple. Although they remain soft, these leaves and flowers last for several years and may be wiped clean without fear of damage. Glycerine drying is most suitable for foliage preservation due to its osmotic nature, therefore; the foliage thus preserved and retains flexibility, shape and texture. Finding out an appropriate concentration of glycerine for better quality of foliage dehydration is important to support the entrepreneurs in the competitive global flower market. A dried flower arrangement without foliage may seem stiff and unnatural. Leaves add much to an arrangement and can easily be preserved by a process known as “glycerinizing.” This technique makes the leaves and stems soft, pliable and long-lasting so they may be used over and over. From the present studies it is concluded that 1:3 ratio of glycerine and water was found most suitable for most of the species studied followed by 1:2 and as far as the method of glycerinization is concerned for asparagus and fern full dip method and for cordyline and silver oak uptake method was found better for most of the parameters studied.

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