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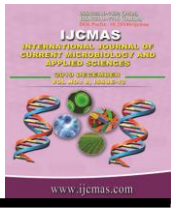

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Effect of Drying Techniques on Different Ornamental Parameters of Bottle Brush (*Callistemon lanceolatus* DC.)

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A B S T R A C T

The fresh flowers are perishable in nature and have limited life, due to this we can't keep these flowers for very long time but now the charm of fresh flowers can be maintained and preserved from few months to years by the technique of drying. Such dried flowers become free from bondage of season. In Indian flower export dried flowers have been contributing nearly 70% of the total export. Bottle brush is a small evergreen tree, grows up to 7-8 meter height and bears bottle brush shaped crimson-red inflorescence on drooping branches. Its flower generally blooms during October-November but its inflorescence has very limited life, therefore we can't enjoy their beauty for long time or round the year. But now it is possible by preserving its beauty by the technique of drying. Therefore for study of drying techniques and their effect on different ornamental parameters of bottle brush flowers, experiments were conducted at the Department of Vegetable Science and Floriculture, CSKHPKV, Palampur. In these experiments inflorescence of bottle brush were taken for study and subject to drying in twenty treatment combinations of five embedding materials viz. open drying (E_0), boric acid (E_1), silica gel (E_2), sand (E_3) and saw dust (E_4) and four drying methods viz. room temperature (D_1), hot air oven (D_2), microwave oven (D_3) and solar drier (D_4) at different temperature level and for varied duration. Standardized temperature level and time duration for drying were recorded in each treatment and then these standardized techniques were evaluated for knowing best drying techniques for this plant. Evaluation of best drying techniques and their effect on different ornamental parameters of bottle brush flowers were performed on the basis of evaluation of different ornamental parameters of flowers viz. colour, shape, texture and overall ornamental value and best drying techniques have been worked out i.e. (I) embedded drying in silica gel and hot air oven at 45° C for 18 hours. (II) embedded drying in silica gel and room temperature for 9 days; (III) embedded drying in silica gel and microwave oven at 450 wt for 2+2 minutes. It was also found that dried flowers of bottle brush can be used in preparing various dried floral crafts e.g. flower arrangement in vases/ pots, swags, wall hangings, floral jewellery, rangooli etc.

Introduction

Fresh flowers are perishable and delicate in nature and can't retain their beauty and fresh look for long period, Thus flower can be dried and preserved to retain its beauty by different drying techniques. The charm of dried flowers can be maintained from few months to years.

The main characters of dried flowers include novelty, longevity, aesthetic flexibility and round the year availability. Drying of flower is 150 crore industry in India and has shown an annual growth rate of 15%. Dry flowers have great export potentiality, as nearly 70% of export of floricultural commodities consists of dried products.

Bottle brush is a small evergreen tree, which belongs to the family Myrtaceae and is a native of Australia (Bailey and Bailey, 1976). Plant grows up to 7-8 meter height, leaves dull green, linear lanceolate 5-7 cm long. The inflorescence bottle brush shaped on drooping branch, 7-12 cm long, bears crimson red flowers. Blooming comes in February-April and September-November. Fruits dark brown in colour. It is a cultivated plant generally propagated by layering, hard wood cutting and seed.

The plant grown in garden as specimen and avenue tree and also suitable for fresh flower arrangements. But these flowers have limited vase life 3-4 days. Hence this flower was selected for preserving their beauty through drying for much longer period, enabling one enjoy their beauty round the year even at home and office along with an additional benefit of value addition in the form of various dried floral crafts viz. flower arrangements in vases/pots, swags, wall hangings, floral jewelry etc. Therefore considering its importance, an attempt has been made to study the effect of drying techniques on different ornamental parameters of bottle brush flower.

Materials and Methods

The study was conducted in the Department of Vegetable Science and Floriculture, CSKHPKV, Palampur, H.P. In the first year of study, investigations were conducted during main blooming season of bottle brush plant i.e. Identification of ornamental plant parts for drying, best time and ideal stage of collection of ornamental material for drying, for these studies repeated visits were made in the identified areas of its growing. Ornamental part and ideal stage of their collection were identified on the basis of morphological and phenological characters of plant, respectively.

After these studies an attempt was also made i.e. experiment 'A' for standardization of drying techniques (treatment combinations) in the first year. For this experiment inflorescence (flowers) of bottle brush were collected from plant at appropriate time and stage when the flowers have similar visual appearance.

The flowers were harvested in the morning hours before 11 a.m., when dew drop was evaporated completely and these flowers were carrying in herbarium vasculum during collection. After collection, ornamental material was prepared for drying by removing infested, distorted and faded parts from them.

Twenty treatment combinations, consisting five embedding materials viz. open drying (E_0), boric acid (E_1), silica gel (E_2), sand (E_3), saw dust (E_4) and four drying methods viz. room temperature (D_1), hot air oven (D_2), microwave oven (D_3), solar drier (D_4) were used in drying.

For open drying, material either hanged on strings or kept openly in vases in different drying methods and for embedded drying material was embedded in different embedding materials. Aluminum containers

were used for embedding in room temperature, hot air oven and solar drier, while glass-ware was used in microwave oven. Three samples of ornamental material i.e. flowers were subject to drying in these twenty treatment combinations at varying temperature level and time duration repeatedly and finally standardized temperature level and time duration were recorded as unit days in room temperature; hours in hot air oven; minutes in microwave oven and light hours in solar drier. Once the flowers are dried, remove the container from the drying equipments and leave it at room condition until the desiccant is cool, this time is called setting period i. e. 2-3 hours. After this period flowers were taken out from embedding material and tapping them with finger slowly, so as to remove the desiccant over and around the flower.

The field observations were also repeated in the second year by re-visit in the identified areas of previous year. After taking these observations an attempt was also made i.e. experiment 'B' for evaluation of drying techniques and their effect on different ornamental parameters of bottle brush viz. colour, shape, texture and overall ornamental value of bottle brush flower. The experiment 'B' was carried out in factorial completely randomized design (CRD) with 20 treatment combinations (mentioned above), 3 replications and 3 samples were used in each replication. In this experiment visits were repeated for collection of plant material and material was prepared as previous mentioned method. Then ornamental material i.e. inflorescence (flowers) were subject to drying in all twenty treatment combinations at standardized temperature level and time duration. After drying fresh as well as dried flowers of bottle brush were visually judged and compared for different ornamental parameters i.e. colour (5), shape (3), texture (2) and overall ornamental value (10) and scores were assigned to these parameters out of maximum score, which is given in parenthesis. First three parameters i.e. colour, shape and texture were simply statistically analyzed by averaging their respective values, while score of overall ornamental value is a sum of score awarded to rest three parameters, which have different weights i.e. colour (50%), shape (30%), texture (20%), so with respect to statistical need in this case awarded score of these three parameters were converted in respective weighted score as per the method advocated by Hamburg (1974). Then final data were analyzed by using the standard statistical methods. After evaluation of best drying techniques of bottle brush flower. The flowers of this plant were dried in large quantity by using best drying techniques and used in making various dried floral crafts.

Weighted Score

For calculating the weighted score of overall ornamental value, value (score) awarded to three ornamental parameters i.e. colour, shape, texture were multiply by their respective weights i.e. colour (0.5), shape (0.3) and texture (0.2). The value so obtained was aggregated and this resulted the weighted score of overall ornamental value.

WS= Weighted score of overall ornamental value

WS = cX0.5+ sX0.3+ tX0.2

MWS= Maximum weighted score of over all ornamental value

MSW = cX0.5+ sX0.3+ TX0.2

= 5X0.5+ 3X0.3+ 2X0.2

= 3.8

WS_{10} = Weighted score of overall ornamental value at 10 point scale

$$WS_{10} = \frac{WS \times 10}{3.8}$$

Where:

c = Score awarded to colour of a specimen (out of 5)

s = Score awarded to shape of a specimen (out of 3)

t= Score awarded to texture of specimen (out of 2)

Results and Discussion

Ornamental part

Bottle brush shaped, crimson-red inflorescences (flowers) in drooping branches were observed as ornamental part of bottle brush, which was also found suitable for drying purpose. These characters of bottle brush flower also reported by Kashyap (2000)

Time and Stage of collection

Best time for collection of inflorescence (flowers) from bottle brush plant, observed during February-April and September-November, these times are being also supported with the study of Desh Raj (1991).

Mature inflorescences were found suitable for its drying. In a study Singh (2003) also suggested that flowers for drying should be cut just as they come to maturity.

Standardization of drying techniques

Different drying techniques (treatment combinations) were standardized for drying of bottle brush flower s in experiment 'A'. Results of experiment have been presented in Table.1 and discussed here.

Room temperature

Standardized drying techniques in room temperature and different embedding materials were recorded as open drying (E_0) -6 days, boric acid (E_1) -9 days, silica gel (E_2) -9 days, sand (E_3) -9 days, saw dust (E_4) - 9 days. Geetha *et al.,* (2002) reported that time required for microwave oven drying of Indian blue water lily was 4 minutes, whereas for shade drying it was 14 days. It supports standardized duration of room temperature drying in present study.

Hot air oven

Standardized drying techniques in hot air oven and different embedding materials were recorded as open drying (E_0) -45^{o}C, 12 hours, boric acid (E_1) -45^{o}C, 48 hours, silica gel (E_2) -45^{o}C, 18 hours, sand (E_3) -45^{o}C, 48 hours, saw dust (E_4) -45^{o}C, 24 hours. Standardized temperature level and time required for hot air oven drying also supported by Bhutani (1995).

Microwave oven

Standardized drying techniques in microwave oven and different embedding materials were recorded as open drying (E_0) -450 wt, 2+2 minutes, boric acid (E_1) -600 wt, 2+2+2 minutes, silica gel (E_2) -450 wt, 2+2 minutes, sand (E_3) -600 wt, 2+2+2+2 minutes, saw dust (E_4) -450 wt, 2+2 minutes. Bhattacharjee and Naveen kumar (2002) reported standardized time for microwave oven drying for some flowers viz. chrysanthemum -3minutes, helichrysum -2.30 minutes, protea -1 minute. These findings support time required for microwave oven drying in present study.

Solar drier

Standardized drying techniques in solar drier and different embedding materials were recorded as open drying (E_0) -10 light hours,

boric acid (E_1) -15 light hours, silica gel (E_2) -15 light hours, sand (E_3) -15 light hours, saw dust (E_4) -15 light hours. Findings of an experiment conducted by Simalenga *et al.*, (1990) shows that in solar drier material can be dried in few hours (8-10 hrs), in spite of open drying, which takes 7-14 days for same drying. These results support standardized duration of solar drying in present study.

Evaluation of drying techniques

Study on evaluation of drying techniques (treatment combinations) of bottle brush flowers were conducted in experiment 'B' by evaluating different ornamental parameters of flowers i.e colour, shape, texture and overall ornamental value. The results of experiment have been presented in Table 2. Interpretation of these results revealed that.

Colour

Significant effect of embedding materials and treatment combinations and non-significant effect of drying methods were observed on this parameter.

Among embedding materials E_2 (3.96) obtained highest score of colour, followed by E_4 (3.44), while poor results were recorded in E_0 (3.13), which was statistically at par with E_3 (3.19) and E_1 (3.32).

Treatment combination E_2D_2 (4.22) showed best result for this parameter and statistically at par with E_2D1 (4.11), and E_2D_3 (3.88) and poor result in E_3D_3, E_1E_4, E_0D_2 and E_0D_1 with mean score (2.77), which were also statistics at par with each other. Dahiya *et al.*, (2002) also reported that when annual chrysanthemum flowers dried in combinations of different embedding materials and drying methods, best results were found in combinations of silica gel with different drying methods.

Shape

Influence of embedding materials, drying methods and treatment combinations on this parameter have shown significant. Within embedding material maximum score of shape was recorded in E_2 (2.05), followed by E_1 (1.66), E_4 (1.38) and minimum in E_3 (1.13). Desh Raj and Gupta (2003) also reported silica gel as best embedding material for getting good result during drying. Drying methods D_1 (1.75) was showed best result with respect to this parameter and poor result in D_3 and D_1 with mean score (1.35). Treatment combinations were showed best result in E_1D_2, which was statistically at par with E_2D_2 and E_2D_4 with mean score (2.22), while poor results were recorded in combination E_3D_3 (0.88) which was at with E_4D_1 (1.00), E_3D_1 (1.00) and some other combinations.

Texture

Embedding materials and drying methods were significantly influenced the texture of bottle brush flowers, however their combinations could not exert significant influence on this parameter. Embedding materials were showed maximum score of texture in E_2 (1.68), followed by E_1 (1.44), E_3 (1.30) and minimum in E_0 (0.60). Within drying methods best result was obtained in D_1 (1.43), which was statistically at par with D_2 (1.37) and poorest in D_4 (1.10) and D_3 (1.15). The similar results have been reported by Venugopal and Patil (2000).

Overall ornamental value

Effect of embedding materials, drying methods and treatment combinations were recorded significant on this parameter. Among embedding materials highest weighted score was recorded for this parameters in E_2 (7.72), followed by E_1 (6.48) and E_4 (6.29) and lowest in E_0 (5.41) and E_3 (5.77).

Table.1 Standardization of drying techniques of *Callistemon lanceolatus* DC.

Experiment-A

S. No.	Treatment combinations	Standardization of drying techniques	S. NO.	Treatment combinations	Standardization of drying techniques
1.	E_0D_1	6 days	11.	E_2D_3	450 wt., 2+2 minutes
2.	E_0D_2	45°C, 12 hours	12.	E_2D_4	15 light hours
3.	E_0D_3	450 wt., 2+2 minutes	13.	E_3D_1	9 days
4.	E_0D_4	10 light hours	14.	E_3D_2	45°C, 48 hours
5.	E_1D_1	9 days	15.	E_3D_3	600 wt. 2+2+2+2 minutes
6.	E_1D_2	45°C, 48 hours	16.	E_3D_4	15 light hours
7.	E_1D_3	600 wt., 2+2+2 minutes	17.	E_4D_1	9 days
8.	E_1D_4	15 light hours	18.	E_4D_2	45°C, 24 hours
9.	E_2D_1	9 days	19.	E_4D_3	450 wt., 2+2 minutes
10.	E_2D_2	45°C, 18 hours	20.	E_4D_4	15 light hours

Embedding materials:

E_0 -Embedding material not used (Open drying), E_1-Boric acid, E_2-Silica gel, E_3 -Sand, E_4-Saw dust

Drying methods:

D_1 – Room temperature, D_2 - Hot air oven, D_3 - Microwave oven, D_4 - Solar drier

Table.2 Evaluation of drying techniques of *Callistemon lanceolatus* DC.

Experiment-B

Factors	Ornamental Parameters																			
	Colour					Shape					Texture					Overall ornamental value				
A\B	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean
E_0	2.77	2.77	3.22	3.77	3.13	1.33	1.11	1.22	1.33	1.24	0.66	0.66	0.44	0.66	0.60	5.03	4.85	5.42	6.36	5.41
E_1	3.55	3.44	3.55	2.77	3.32	1.55	2.22	1.55	1.33	1.66	1.44	1.55	1.55	1.22	1.44	6.65	7.24	6.71	5.33	6.48
E_2	4.11	4.22	3.88	3.66	3.96	1.88	2.22	1.88	2.22	2.05	1.77	1.66	1.77	1.55	1.68	7.81	8.17	7.52	7.38	7.72
E_3	3.33	3.33	2.77	3.33	3.19	1.00	1.55	0.88	1.11	1.13	1.66	1.33	1.00	1.22	1.30	6.03	6.30	4.87	5.89	5.77
E_4	3.44	3.33	3.44	3.55	3.44	1.00	1.66	1.22	1.66	1.38	1.66	1.66	1.00	0.88	1.30	6.18	6.56	6.01	6.44	6.29
Mean	3.44	3.41	3.37	3.41	3.40	1.35	1.75	1.35	1.53	1.49	1.43	1.37	1.15	1.10	1.26	6.34	6.62	6.10	6.28	6.33
	A		B		A X B	A		B		A x B	A		B		A x B	A		B		A x B
SEd	0.105		0.093		0.210	0.082		0.073		0.164	0.102		0.091		0.205	0.184		0.165		0.369
C.D.at 5%	0.212		N.S.		0.424	0.165		0.148		0.331	0.207		0.185		N.S.	0.373		0.333		0.746
C.V.(%)	7.54					13.44					19.81					7.14				

N.S. = Non-significant

Factors:

A. Embedding Materials - (E_0 –Embedding material not used (Open drying), E_1 - Boric acid, E_2 - Silica gel, E_3 - Sand, E_4 - Saw dust)

B. Drying Methods - (D_1 - Room temperature, D_2 - Hot air oven, D_3 - Microwave oven, D_4 - Solar drier)

A x B. Interaction - (Embedding material x Drying methods)

Note:

- Values in tables of colour, shape and texture have been given as average of normal score awarded to these parameters out of 5, 3 and 2, respectively.
- Values in table of overall ornamental value have been given as average of weighted score calculated for this parameter on10 points scale.

Similarly Thomas (1979) reported that silica gel, when used as embedding material for flower drying, flower retain overall ornamental value viz. brightness of colour, beauty of form.

Drying methods have shown best result in D_2 (6.62) and poorest in D_3 (6.10) which was at par with D_4 (6.28) and D_1 (6.34). With respect to treatment combinations maximum weighted score was recorded in E_2D_2 (8.17), which was also statistically at par with E_2D_1 (7.81) and E_2D_3 (7.52) and lowest in E_0D_2 (4.85), E_3D_3 (4.87) and E_0D_1 (5.03), all these combinations were found at par with each other.

These results are being also supported with the study of Jayanthi and Aravinda (2003) who reported that when chrysanthemum cv. button type dried in different drying techniques gave best result in microwave oven and silica gel. Thus on the basis of evaluation of overall ornamental value with respect to different treatment combinations, three best drying techniques (treatment combinations) were recommended for drying of bottle brush flowers viz. (I) E_2D_2 – 45^{o}C, 18 hours, (II) E_2D_1 -9 days, (III) E_2D_3 -400 wt, 2+2 minutes.

It was also found that dried flowers of bottle brush can be used in preparing various dried floral crafts viz. flower arrangement in vases/ pots, swags, wall hangings, floral jewellery, rangooli etc. Naresh Chandra (1987) also reported different decorative product, which can be prepared by dried flowers and foliage of different cultivated ornamental plants e.g. portraits, greeting cards, sceneries etc.

These floral crafts have good demand in domestic as well as in international market. Therefore it was concluded that beauty of bottle brush inflorescence can be enjoyed in off season by its drying and making various value added product in the form of dried floral crafts.

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