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Storage studies of dried carnation flowers

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Abstract
The present experiment entitled "Effect of desiccants on drying of carnation flower was carried out during the academic years 2015-16 and 2016-17 at Department of Horticulture, Post Graduate Institute, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola to find out suitable desiccant for drying for carnation flower. The experiment was laid out in Randomized Block Design with four replications. The treatments comprised of six different drying methods viz. Air drying under shade (control), drying after embedding in borax, clean fine sand, silica gel, 1:1 glycerol: water and 1:3, 1:1 glycerol: water. Embedded drying in silica gel scored maximum scores for extent of colour fading at 60, 150 and 180 days after drying during storage, whereas minimum scores were recorded in treatment of air drying under shade. With respect to incidence of pest and diseases scores of flowers during storage at 60, 150 and 180 days after drying, treatment silica gel embedded drying scored maximum points whereas minimum scores and maximum damage by pests and diseases were recorded in treatment in air drying under shade treatment.

Keywords: Storage, flower, drying temperature dehydration, colour, damage, score

Introduction
Shelf life of fresh cut flowers is limited, in spite of using best chemicals for improvement of keeping quality and enhancement vase life. Hence, the fresh cut flowers cannot be stored for a long time. Non availability of flowers at times and places where one wants them very much is an additional problem. Efforts are being made since centuries to find alternatives for fresh flowers. For these efforts, dried flowers hold an economic and eco-friendly answer.

In this context flowers can be dried, preserved and processed to retain its beauty as well as everlasting value. The use of dried flowers has made it possible to enjoy their beauty for several years. Therefore, to overcome this problem as well as maintaining the charm of the flowers, the application of dehydration technology can play a vital role. Many value-added products can be made from dried flowers such as collages, flower pictures, flower balls, greeting cards, covers, pomanders, festive decorations, bouquets and wreaths and sweet-smelling pot pourries (Raghupathy *et al*., 2000) [5].

Carnation is essentially a florist crop, widely cultivated on commercial scale in different part of the world. It belongs to the family *Caryophyllaceae* and member of genus *Dianthus*. Drying of flowers and foliage by various methods like air drying, sun drying, oven and microwave oven drying, freeze drying and embedded drying can be used for making decorative floral crafts items like cards, floral segments, wall hangings, landscapes, calendars, potpourris etc. for various purposes (Bhutani 1990) [1] Potpourris being the major segment of drying flower industry valuing at Rs 55 crore in India alone. Dried flowers are a good standby for the florist's, since designs can be made up during the slack periods and arrangements can be displayed where fresh flowers are unsuitable from the growers point of view and the price is less than equivalent fresh flowers (Salinger 1987) [8].The demand for dry flowers and attractive plant parts, dried floral arrangements and floral crafts has increased manifold during the last decade. Dry flowers constitute more than two-thirds of the total floriculture exports. The demand for dry flowers is increasing at an impressive rate of 8-10 per cent annually thus offering a lot of opportunities for the Indian entrepreneurs to enter in the global floricultural trade (Singh 2009) [9]. Thus, looking to the importance of dry flower, experiment was conducted on storage studies of dried carnation flower.

Materials and Methods

The present investigation was conducted in the Laboratory, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the year 2015-16 and 2016-17. The cut flowers of carnation were produced under naturally ventilated polyhouse. The healthy, disease free and uniform flower stems of carnation were harvested in the morning hours between 8.00 to 9.00 am. Immediately after harvest, the cut ends of the flower stalks were immersed in water. After bringing to the laboratory, the flowers were sorted for petal damage, pests and diseases. Stems of uniform size were selected and trimmed to 10 cm length and the treatments were imposed immediately.

To overcome the problem of petal shrinkage, the flowers were dried by embedding in borax, sand and silica gel. Plastic containers were used for embedding at room temperature. About one-inch layer of the desiccant was poured into the bottom of container and the flower stems were pushed into the medium. Desiccant was then gently and gradually poured all around and over the flower upto 4 to 5 cm above, so as to fill all the crevices in between the petals without disturbing the shape of flowers. After embedding the flowers with desiccants, the containers were kept at room temperature in a well-ventilated room for dehydration. At the end of drying, the petals of the flowers were pressed with fingers to check the presence of moisture. If the moisture was still present, then the flowers were further exposed for drying for complete elimination of moisture. The well dried flowers were packed in cardboard boxes and stored at ambient temperature and observations were recorded on extent of colour fading and damage of dried flowers for six months at 30 days intervals by scoring on a five point scale given by Safeena (2005) [7] viz. very low - 3.5-4.0, low - 2.5-3.4, medium - 1.5-2.4, high - 0.5-1.4 and very high- 0.0-0.4. The data was analyzed statistically using RBD variance as per methods given by Panse and Sukhatme (1985) [4].

Results and Discussion

Colour fading of dried carnation flowers

Data pertaining to the years 2015-16, 2016-17 and pooled on extent of colour fading scores of dried carnation flowers are presented in Table 1 and 2. at 30, 60, 150 and 180 days after drying.

Table 1: Effect of desiccants on extent of colour fading scores of dried carnation flowers at 60 and 180 days after drying

Treatment	Scores at 60 DAD			Scores at 180 DAD		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
(T_1) Shade drying (Control)	1.23	1.18	1.20	1.15	1.18	1.16
(T_2) Borax embedding	3.63	3.58	3.60	3.58	3.55	3.56
(T_3) Sand embedding	3.53	3.65	3.59	3.45	3.60	3.53
(T_4) Silica gel embedding	3.70	3.75	3.73	3.70	3.78	3.74
(T_5) Glycerol : Water 1:1	1.45	1.65	1.55	1.55	1.60	1.58
(T_6) Glycerol : Water 1:3	1.33	1.58	1.45	1.58	1.73	1.65
F Test	Sig.	Sig.	Sig.	Sig.	NS	Sig.
SE (m) ±	0.15	0.16	0.07	0.17	0.13	0.12
CD at 5%	0.44	0.49	0.20	0.53	-	0.35

At 60 days, maximum sensory scores (3.70, 3.75 and 3.73) were recorded in treatment T_4, (silica gel embedding) which was at par (3.63, 3.58 and 3.60) and (3.53, 3.65 and 3.53) with treatment T_2 (borax embedding) and treatment T_3 (sand embedding), while minimum scores (1.23, 1.18 and 1.20) were found in treatment T_1 (shade drying) during the years 2015-16, 2016-17 and in pooled result, respectively .

At 180 days, maximum scores (3.70, 3.78 and 3.74) were recorded in treatment T_4 (silica gel embedding), which was at par (3.58 3.55 and 3.56) and (3.45, 3.60 and 3.53) with treatment T_2 (borax embedding) and T_3 (sand embedding), while minimum scores (1.15, 1.18 and 1.16) were found in treatment T_1 (shade drying) during the years 2015-16, 2016-17 and in pooled result, respectively.

Incidence of pest and diseases of dried carnation flowers

Data pertaining to the years 2015-16, 2016-17 and pooled on incidence of pest and diseases scores of dried carnation flowers are presented in Table 3 and 4. at 30, 60, 150 and 180 days after drying.

Table 2: Effect of desiccants on incidence of pest and diseases scores of dried carnation flowers at 60 and 180 days after drying

Treatment	Scores at 60 DAD			Scores at 180 DAD		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
(T_1) Shade drying (Control)	1.23	1.18	1.20	1.53	1.43	1.48
(T_2) Borax embedding	3.63	3.58	3.60	3.58	3.55	3.56
(T_3) Sand embedding	3.53	3.65	3.59	3.53	3.50	3.51
(T_4) Silica gel embedding	3.70	3.75	3.73	3.68	3.70	3.69
(T_5) Glycerol : Water 1:1	1.45	1.65	1.55	2.00	2.15	2.08
(T_6) Glycerol : Water 1:3	1.33	1.58	1.45	2.00	1.85	1.93
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±	0.15	0.16	0.07	0.15	0.19	0.12
CD at 5%	0.44	0.49	0.20	0.45	0.57	0.37

At 60 days, data was found to be significant regarding incidence of pest and diseases scores of dried carnation flowers as influenced by drying methods. Significantly, maximum scores (3.70, 3.75 and 3.73) were recorded in treatment T_4, (silica gel embedding) which was at par (3.63, 3.58 and 3.60) and (3.53, 3.65 and 3.59) with treatment T_2 (borax embedding) and treatment T_3 (sand embedding), while minimum scores (1.23, 1.18 and 1.20) were found in treatment T_1 (shade drying) during the years 2015-16,2016-17 and in pooled result, respectively .

At 180 days, data was found to be significant regarding incidence of pest and diseases scores of dried carnation

flowers as influenced by drying methods. Significantly, maximum scores (3.68, 3.70 and 3.69) were recorded in treatment T_4 (silica gel embedding), which was at par (3.58 3.55 and 3.56) and (3.53, 3.50 and 3.51) with treatment T_2 (borax embedding) and treatment T_3 (sand embedding), while minimum scores (1.53, 1.43 and 1.48) were found in treatment T_1 (shade drying) during the years 2015-16,2016-17 and in pooled result, respectively.

Table 4: Effect of desiccants on incidence of pest and diseases of carnation flowers at 150 and 180 days after drying

Treatment	Scores at 150 DAD			Scores at 180 DAD		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
(T_1) Shade drying (Control)	1.23	1.20	1.21	1.53	1.43	1.48
(T_2) Borax embedding	3.53	3.25	3.39	3.58	3.55	3.56
(T_3) Sand embedding	3.55	3.50	3.53	3.53	3.50	3.51
(T_4) Silica gel embedding	3.60	3.83	3.71	3.68	3.70	3.69
(T_5) Glycerol : Water 1:1	1.53	1.48	1.50	2.00	2.15	2.08
(T_6) Glycerol : Water 1:3	1.73	1.68	1.70	2.00	1.85	1.93
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±	0.17	0.21	0.12	0.15	0.19	0.12
CD at 5%	0.51	0.65	0.37	0.45	0.57	0.37

At 150 days, maximum scoress (3.60, 3.83 and 3.71) were recorded in treatment T_4 (silica gel embedding), which was at par (3.53, 3.25 and 3.39) and (3.55, 3.50 and 3.53) with treatment T_2 (borax embedding) and treatment T_3 (sand embedding), while minimum scores (1.23, 1.20 and 1.21) was found in treatment T_1 (shade drying) during the years 2015-16,2016-17 and in pooled result, respectively.

At 180 days, maximum scores (3.68, 3.70 and 3.69) were recorded in treatment T_4 (silica gel embedding), which was at par (3.58, 3.55 and 3.56) and (3.53, 3.50 and 3.51) with treatment T_2 (borax embedding) and treatment T_3 (sand embedding), while minimum scores (1.53, 1.43 and 1.48) were found in treatment T_1 (shade drying) during the years 2015-16,2016-17 and in pooled result, respectively.

These results are in accordance with the findings of Smith (1993) [10]. Thomler (1997) [11] suggested that well dried flowers could be stored in cardboard boxes in a cool dry place. The dried material had to be held firmly to avoid breakage. Rengasamy *et al*. (1999) [6] reported that selection of proper packaging, giving proper cushioning and use of moisture barrier packaging materials are of prime consideration in dry flower industry. Boxes should be free from insects since they chew the soft tissue and flower petals. Yan (1999) [12] recommended the wrapping of dried flowers in newspaper and placing them in a cardboard box. The box should not be stored in an unusually damp or very dry place. A few moth balls can be kept to protect from small rodents and insects. Similar results are also obtained by Safeena (2005) [7] during his work.

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