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INFLUENCE OF TEMPERATURE AND EMBEDDING MEDIA ON PRODUCTION OF QUALITY DRY FLOWERS OF AFRICAN MARIGOLD *CV.* PUSA NARANGI GAINDA

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Abstract

The present study was conducted to standardize the embedding media and temperature for drying of flowers of African marigold cv. Pusa Narangi Gainda. Fresh, healthy, fully opened flowers with 5 cm pedicel were embedded in four embedding media namely saw dust, fine sand + silica gel at 2:1 proportion, river sand and borax + corn meal at 1:1proportion with three replications. Flowers embedded in all these embedded media were dried in hot air oven at a temperature of 45^0 C and calculated the number of hours required for complete drying. The results revealed that flower quality was affected to a marked extent by the desiccants tried. Flowers embedded in fine sand + silica gel (2:1) took a less duration of 50 hours for complete drying. Maximum reduction of flower size (20.02%), highest percent of moisture loss from flowers (63.48) were achieved in saw dust embedded flowers. Acceptable quality parameters like colour retention was found well in saw dust embedded flowers although shape and texture were good with river sand.

Key words: embedding media, dehydration, marigold, colour, brittleness of petals

Introduction

Flowers are being used from time immemorial and an integral part of the daily life. Decorating the living places with available fresh and dry flowers is indiscriminately increasing with the urbanization. Availability of fresh flowers is a season bound and by using the best preservatives, vase life can be extended for a countable period. If the flowers, foliage and other plant parts could be dried, it is possible to supply the flowers throughout the year without affecting the aesthetic value (Malcom, 1994). Hence the importance of dry flowers provides a means of value addition and employment generation (Datta and Roy, 2011). Dry flowers that are near natural, remain their shape, size and colour as they were before drying and provides raw material for interior decoration. The demand for dry flowers is increasing in domestic market at the rate of 8-11% annually thus offers a lot of scope to the Indian entrepreneurs to enter into the global floricultural trade (Singh, 2009).

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The drying technique involves reducing the moisture content of flowers to a point at which biochemical changes are minimized while maintaining cell structure, pigment level and flower shape (Singh and Dhaduk, 2005). The dried material might be made into a variety of products ranging from wall hangings, greeting cards, paper weights, dry flower arrangements, pot pourii, home decoratives etc (http://edis.ifas.ufl.edu). Various approaches or techniques are employed for dehydration of flowers and other ornamentals were reported by several authors (Bhutani, 1995; Westland, 1995). Press drying and embedding methods are used for drying of flowers on commercial scale. Drying of flowers by embedding method is one the most common, which can be done throughout the year with a suitable embedding material to establish a small scale cottage industry can come up for employment generation by utilizing the locally available flora and fauna (Batra, 2016).

Marigold is an annual flower with its wide use in landscaping and also at industrial level which offers a potential for dry flowers with its attractive colour and shape. With this all facts the present study was laid out to standardize the embedding material for drying of African marigold (*Tagetus erecta* L.) *cv.* Pusa Narangi Gainda flowers.

Materials and Method

The present experiment was carried out at the departmental laboratory, Department of Floriculture, Medicinal and Aromatic Plants during December to February, 2016. Fresh, healthy, fully opened flowers with a 5 cm pedicel were collected from the Instuctional Farm, UBKV at 10.00-11.00 am during the experimental period. The treatments consist of various embedding media **T_1**- Saw dust, **T_2**- Fine Sand+ Fine Silica Gel (2:1), **T_3**- Fine Sand, **T_4**- Borax+ Corn Meal (1:1). At first the container was filled to a 5cm layer with embedding media then the flowers was placed and the gap was filled by pouring the media above the flower until the whole flower head was covered inside media. Then the containers were placed in hot air oven at a temperature of 45^{0}C until it dries completely. After dehydration process the dried flowers were kept at room temperature atleast for 1-2 hrs to dry completely and for settlement. The dried flowers were removed by tilting the container in order to remove the flowers, remaining media from flowers was removed by using paint brush slowly and gently cleaned the flowers. Drying of the flowers were examined by taking the parameters on flower size at initial and after drying, flower weight both at initial and after drying, flower colour before drying and after drying were recorded before drying as well as after drying.

Results and Discussion

Time period required for dehydration depends on the embedding media that removes the moisture from flowers. It is the evident from Table 1 that duration for complete drying of flowers differed with embedding materials. Among the four embedded media used, saw dust took maximum time for drying of flowers (68 hours) due to its fibrous nature that inherently holds more moisture liable for slow release of moisture from flowers and takes much time for drying by itself thereafter the flowers. Whereas, flowers embedded in fine sand and borax+corn meal (1:1) took an optimum duration of 54 hours. The combination of fine sand + silica gel (2:1) dehydrated the flowers in a less duration of 50 hours. Significant difference in the time taken for drying of flowers due to desiccants was reported by Singh *et al.*, (2004). African marigold flowers subjected to oven drying took 72 hours at a temperature of 45-50^{0}C (Krishna *et al.*, 2012).

Different media acts differentially on reduction in flower size and moisture loss from flowers after drying. Maximum reduction of flower size (20.02%) was recorded when the flowers were embedded in saw dust may be due to longer drying duration coupled with the light weight of saw dust hence it is thoroughly removed the moisture from the flowers followed by fine sand + silica gel (2:1). Least percentage of size reduction was observed in borax + corn meal (1:1) which provides good aeration for rapid drying. Fine sand along with silica gel showed an optimum reduction might be due to the faster hygroscopic nature of silica gel coupled with larger size particles of sand. Rough texture, binding properties, heavier weight of borax and poor absorbing nature of corn meal resist reduction of flower size during dehydration hence it resulted the least reduction of 8.43% (table 2).

Flowers embedded in saw dust readily lost moisture by 63.48% which was maximum followed by 61.20% in

Table1: Duration (hrs) for complete drying in different embedding media of African marigold *cv.* Pusa Narangi Gainda.

Treatment details	48 hrs	50 hrs	54 hrs	68 hrs
T_1- Saw dust	-	-	-	✓
T_2- Fine Sand+Fine Silica gel (2:1)	-	✓		
T_3- Fine Sand			✓	
T_4- Borax + Corn Meal (1:1)	-		✓	

Table2: Effect of embedded media on percent reduction in flower size of African marigold *cv.* Pusa Narangi Gainda after hot air oven drying.

Treatment details	Initial flower size (cm)	Final Flower size (cm)	Reduction in flower size (cm)	Reduction in flower size (%)
T_1- Saw dust	3.67	2.63	1.03	20.02
T_2- Fine Sand + Fine Silica gel (2:1)	4.05	3.23	0.82	14.58
T_3- Fine Sand	3.94	3.14	0.80	14.52
T_4- Borax + Corn Meal (1:1)	3.83	3.38	0.45	8.43
SEm$\pm$	0.42	0.33	0.08	1.64
CD @5%	1.17	0.94	0.25	4.58

Table 3: Effect of embedding media on moisture loss (%) of African marigold *cv.* Pusa Narangi Gainda after hot air oven drying

Treatment details	Initial flower weight (g)	Final Flower weight (g)	Moisture loss (%)
T_1- Saw dust	5.00	0.55	63.48
T_2- Fine Sand+ Fine Silica gel (2:1)	5.56	0.79	61.20
T_3- Fine Sand	4.87	0.79	57.83
T_4- Borax + Corn Meal (1:1)	4.63	0.80	53.23
SEm±	0.54	0.08	6.37
CD @5%	1.53	0.23	17.81

fine sand + silica gel (2:1) and it was minimum in 1:1 ratio of borax+corn meal (53.23%). Presence of free particles in saw dust rapidly removed moisture thereby resulted in more loss in weight and substantially reduced moisture from flowers and also the effect of temperature for prolonged duration (68 hrs) may be due to liberation of more water and circulation of hot air continued for longer duration thereby resulted in moisture loss. Silica gel is composed of a vast network of interconnecting microscopic pores which attract and hold moisture by a phenomenon known as physical adsorption and capillary condensation (safeena *et al*., 2006). Silica gel embedded flowers recorded the maximum moisture loss at all the drying temperatures as reported by Nair and Singh (2011). A similar finding was also observed in silica gel dehydrated flowers of cut roses by Dilta *et al.*, (2014). Sand has a large particle size and heavier in weight and thus absorbs less moisture as well as it is not able to retain moisture for longer duration, consequently moisture is reabsorbed by flowers. Similar observations were also made when sand was employed in embedding of marigold flowers by Radha Rani and Reddy (2015). A mixture of borax + corn meal resulted in less removal of moisture from flowers. Bhattacharjee and De (2003) suggested that borax with the combination of corn meal and alum can be used in a ratio of (1:1 to 6 parts) borax to corn meal for dehydration of flowers specially chrysanthemum and dahlia (Sell, 1993). But in our study, more brittleness of petals, being light in weight which had fewer tendencies to flatten flowers and corn meal forms a fine layer on surface of dried flowers which badly impacts the acceptability was observed with this combination.

Acceptable quality parameters like colour retention was found good in saw dust embedded flowers (fig. 1 &

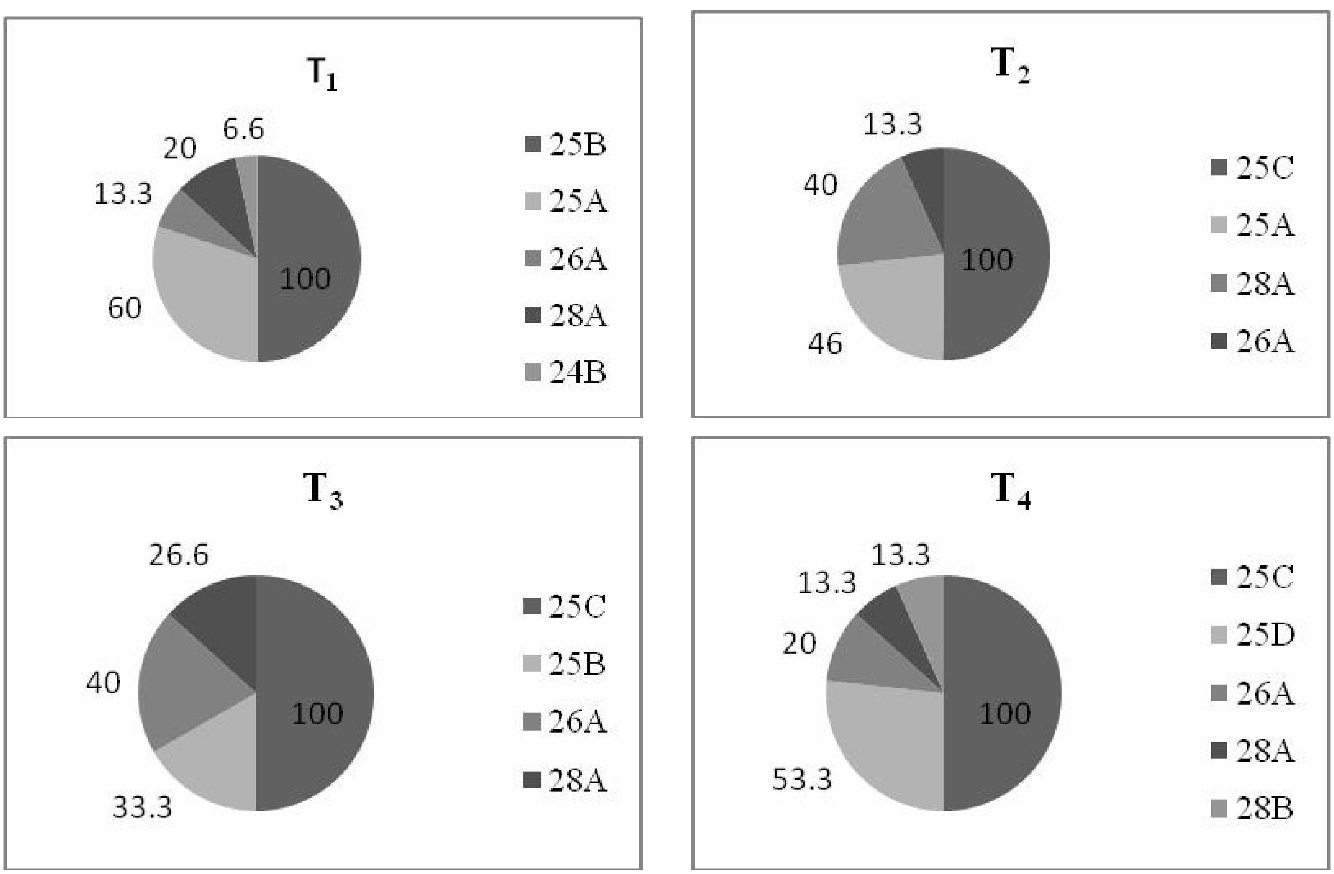

Fig 1: Change in flower colour of African marigold flowers before and after drying (orange-yellow group of RHS, colur chart).

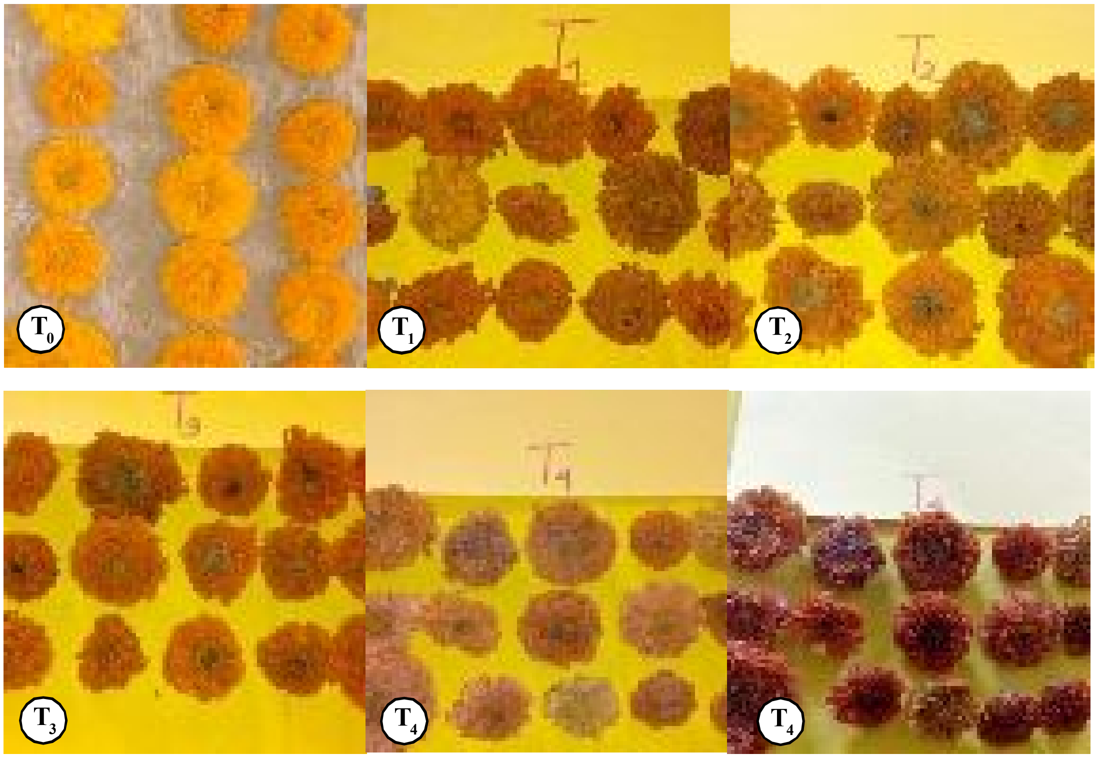

Fig 2: Dried flowers in different embedding materials (**T_0**-before drying, **T_1**- Saw dust, **T_2**- Fine Sand+ Fine Silica gel (2:1), **T_3**- Fine Sand, **T_4**- Borax + Corn Meal (1:1))

fig. 2) but the shape and texture were good with river sand. Work done by many authors found that silica gel resulted in more acceptable quality flowers interms of colour and shape in zinnia and french marigold, rose (Hemant, 2016), helichrysum and statice (Sandhu, 2000), sand for retention of colour, shape and texture (smooth petals) as reported by Singh *et al*. (2004).

From the above findings it is obvious that saw dust which significantly gave well results in removal of moisture, reduced flower size and retention of flower colour good results but poor results in texture and shape retention while river sand performed well for retention of shape and texture and a combination of fine sand + silica gel (2:1) dried the flowers very fast. Therefore our study suggests saw dust could be used to some extent with the combination of other embedding media for drying of flowers.

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