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Storage studies of dried Dutch rose flowers

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Abstract
The present experiments were carried out during the academic years 2013-14 and 2014-15 at Department of Horticulture, Post Graduate Institute, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola to find out suitable desiccant for drying, drying temperature in cabinet oven dryer, suitable time in microwave oven and freeze drying time for Dutch roses. The stem length of each selected cut flower was kept at a uniform length of 10 cm. The flowers were kept in trays with and without embedding in silica gel and dried as per treatments during both the years and data analyzed statistically. Visual quality parameters were used for recording the best treatments and used for storage studies.
Embedded drying in silicagel scored maximum points for colour at 30, 60, 90, 120, 150 and180 days during storage whereas minimum score was recorded by D_4 *i.e* (-80 ^{0}C) for 12 hours in cryo preservation and kept for 7 days at -20 ^{0}C. Tropical Amazon an orange colored variety scored maximum points whereas Bordo scored minimum points for the same. The interaction of D_4C_2 scored maximum points for colour during storage followed by D_1C_3 and D_2C_1.
With respect to damage of flowers during storage at 30, 60, 90, 120, 150 and180 days treatment D4 scored least points and maximum damage by pests and diseases. As regards the cultivars Tropical Amazon dried by embedding in silica gel recorded maximum score during storage up to 180 days in room temperature.

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

Introduction
Floriculture business is expanding rapidly throughout the world. It has tremendous potential for export besides home consumption. Cut flowers are one of the main components of floriculture trade. The demand for fresh cut flowers is increasing day by day and their prices have shot up considerably. The total area under floriculture crops in India was 306 thousand hectares with production of 1840 thousand million tons of loose flowers and 7672 lakh number of cut flowers and the total export of flowers and floriculture products from India during 2014-15 was costing Rs. 460.76 crores (Anon., 2015) [2]. Flowers have been dried, for various reasons from thousands of years. The ancient Egyptians made immensely detailed preparations for their dead to enjoy all that they had during this life in the next one. Many centuries later medieval monks harvested and dried the flowers and an herb by hanging bunches upside down in shade for medicinal use (Susan, 1990) [10].
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, sweet-smelling pot pourries. India, with its vast resources, varied products and experience in the field of dried flowers and plant parts enjoy a distinct advantage in the world export market. The country also enjoys the benefit of cheap labour and favorable climate as against other countries. Dry flower industry is growing very fast with more than 70 per cent share to the floriculture industry in India, a turnover of more than Rs. 385 corers during the year 2013-2014. Our share in the export of these items is below 1.5 per cent in Europe and it, is below one per cent of the world requirements. Netherlands ranks first in the export of dried flowers followed by Columbia, Mexico, India and Israel. The USA is the largest consumer of dried and artificial flowers followed by Germany, UK and Netherlands. Other importing countries are West European countries, Canada, Japan, Hong Kong, Italy, Ethiopia and Australia (Anony, 2014) [1].
The beauty and value of the dried flowers are that they can be kept and cherished for years, which survive the cold of winter and heat of summer. With growing eco-consciousness, the use of more and more nature-friendly things like these come as a natural choice for decoration. The life of dried flowers varies according to the species, texture of their petals and total

consistency of flowers. Dried flowers can be effectively used for making decorative floral craft items for interior decoration and commercial exploitation (Ranjan and Misra, 2002) [6].

There is large potential to develop the dry flower industry in our country and to provide employment to house wives, unemployed youths and rural women. The original shapes, colours and size remain as they were before dehydration and, thus, making them highly suitable raw materials for interior decoration and may be enjoyed for a long time. Present techniques have the ability to develop new markets through diversification of products and promotion of dry flower industry in our country. There is need to create sufficient awareness about the potential of dry flower technology and storage studies.

Materials and Methods

The present experiments were conducted in the Department of Horticulture, Post Graduate Institute, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the years 2013-14, 2014-15 and data is presented in Tables. The healthy, disease free and uniform flowers of Dutch Rose were harvested and brought to the Laboratory. The stem length of each selected cut flower was kept at a uniform length of 10 cm. The leaves present on each cut stem were removed before using them for drying. As per the treatments(drying methods) D_1- Embedded drying in silica gel, D_2-Cabinet oven dryer at 40 ^{0}C + silica gel, D_3- 2.5 M in microwave oven + silica gel, D_4-(-80^{0}C) for 12 h in cryopreservation and cultivars C_1- Bordo, C_2 - Tropical Amazon, C_3- Gold Strike. The well dried flowers were packed in cardboard boxes and stored at ambient temperature and observations were recorded on **e**xtent 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) [8] 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 FCRD variance as per methods given by Panse and Sukhatme (1985) [5].

Results and Discussion

In the present investigation, three Dutch rose cultivars and four drying methods were evaluated for their storability under laboratory condition.

Colour fading of dried Dutch rose flowers

Colour fading of dried Dutch rose flowers during storage at 30, 60, 90, 120, 150 and 180 days was presented in Tables 1 to 2. It was observed from the data that, there was non-significant effect on colour fading of dried Dutch rose flowers at 30 and 60 days after storage. Colour fading of dried Dutch rose flowers was found to be significant during the years 2013-14, 2014-15 and pooled data at 90 days after storage.

During the year 2013-14 significantly, highest sensory score (3.29) was recorded in treatment D_1- *i.e.* embedded drying in silica gel, which was statistically at par with all other drying methods except treatment D_4 which recorded least sensory score (3.09). However, during the year 2014-15, maximum sensory score(3.28) was recorded in treatment D_1 *i.e.* embedded drying in silica gel which was significantly superior over all other treatments. While minimum score (2.99) was recorded in treatments D_3. In pooled result similar trend was also observed, significantly maximum sensory score (3.29) was observed in treatment D_1 which was at par (3.17) with treatment D_2, while minimum (3.09) was recorded in treatment D_4.

As regards the cultivars, there was non-significant effect on colour fading during the year 2013-14. Significantly, highest score (3.30) on colour fading was recorded by cultivar Tropical Amazon a orange colored rose flower during storage, while Gold Strike observed least points (3.01) in the year 2014-15. In pooled result significantly, maximum score for colour fading (3.27) was recorded by cultivar 'Tropical Amazon', while it was found minimum (3.09) in cultivar Gold Strike.

The interactions effect of drying methods and cultivars on colour fading at 90 days after storage was found to be significant during the year 2013-14, 2014-15 and pooled of experimentation. During the year 2013-14, significantly highest points (3.37) were recorded when 'Gold strike' flowers dried by embedding in silica gel,(D_1C_3) which was stastically at par with treatment combinations of D_1C_2 (3.36), D_2C_1 (3.34), D_3C_3 (3.32), D_4C_2 (3.24) and D_2C_2 (3.22), while minimum (2.88) was observed in treatment combination of D_4C_3. In the year 2014-15 significantly highest sensory score (3.53) was observed in treatment combination D_1C_1 which was significantly superior over all other interactions, while least points (2.73) were found in treatment combination D_4C_3. In pooled results significantly maximum score on colour retentation (3.44) during storage was observed in the treatment combination of D_1C_2, which was at par with treatment combinations of D_4C_2 (3.40) and D_1C_3 (3.34), D_2C_1 (3.27) while minimum score (2.80) was recorded in treatment combination D_4C_3.

At 120 days, data pertaining to colour fading on storage was influenced by drying methods, cultivars and their interactions. As regards, drying methods significantly maximum sensory points (3.13) and minimum colour fading was recorded in treatment D_2, which was statistically at par with treatment D_1- (3.10), and minimum (1.85) was recorded in treatment D_4 for colour fading during storage in the year 2013-14.

During the year 2014-15, significantly highest points (3.16) were recorded in treatment D_1 *i.e.* embedded drying in silica gel which was significantly superior over all other drying methods. Significantly least points (1.96) were observed in treatment D_4, on colour fading of dry Dutch rose flowers during storage. In pooled result significantly, maximum points (3.13) on colour fading were recorded in treatment D_1, which was at par with treatments D_2(3.09) and D_3 (2.98), while minimum score (1.90) was recorded in treatment D_4 during storage of dry Dutch rose flowers.

As per cultivars, data on colour fading of dry Dutch rose flowers during the year 2013-14, maximum score (3.11) was found in treatment C_2, while minimum score (3.00) in Gold strike. In the year 2014-15 significantly maximum points (3.17) were recorded in treatment C_2, while least (2.93) in treatment C_1 on colour fading of dry rose flowers during storage. In pooled result highest points (3.14) were recorded in C_2 while least score (2.96) and maximum colour fading was found in treatment C_1.

The data presented in Table 2 regarding interaction effect of drying methods and cultivars indicated that, the treatment combination of D_2C_1 recorded 3.28 points, which was at par with treatment combination of D_1C_2 (3.20) during storage. Least sensory points (1.75) were recorded in treatment D_4C_1, during the year 2013-14. In the year 2014-15, significantly highest points (3.45) were recorded in treatment combination D_1C_2 which was at par with treatment combination D_1C_2 (3.30), whereas significantly lowest points (1.69) on colour fading of dry flowers were observed in treatment combination D_4C_1. In pooled result treatment combination of D_1C_2 - recorded significantly maximum sensory score (3.25) for

colour fading during storage of dry Dutch rose flowers which was at par with treatment combinations of D_2C_1 (3.24), D_1C_1 (3.22), D_1C_3 (3.13), D_2C_2 (3.05) D_3C_2(3.04) and D_3C_3(3.01).Significantly minimum score (1.72) was recorded in treatment combination D_4C_1.

The perusal of Table 2 reveals that, at 150 days after storage drying method, D_1, *i.e.* embedded drying in silica gel recorded significantly maximum score (2.40, 2.50 and 2.45) and minimum score (1.73, 1.71 and 1.72) was found in treatment D_4 during the years 2013-14, 2014-15 and pooled data, respectively. Significantly maximum score (1.86, 2.08 and 1.87) for colour fading was recorded in treatment C_3 while it was found minimum in treatment C_1 during the years 2013-14, 2014-15 and pooled data, respectively.

The interaction effect of drying methods and cultivars on colour fading was found to be significant during the year 2013-14. Maximum sensory score 2.48 was observed in treatment combination of D_2C_1 which was at par with treatment combinations of D_1C_3 (2.42), D_1C_2 (2.42), D_1C_1 (2.38) and D_2C_2 (2.36) whereas significantly least score (0.66) recorded in treatment combination D_4C_1.Similarly during the year 2014-15 treatment combination D_1C_2 recorded significantly maximum score (2.59) for colour fading during storage which was statistically at par with treatment combinations D_2C_1 (2.50) and D_1C_3 (2.43), whereas significantly minimum score was recorded (0.62) in treatment combination D_4C_1. In pooled result, significantly maximum sensory score (2.51) was found in treatment combinations D_1C_2 which was at par with treatment combinations of D_1C_3 (2.42) and D_2C_1 (2.49) while minimum score (0.64) was found in D_4C_1.

At 180 days after storage with respect to drying methods, significantly maximum score (1.69,1.49 and 1.59) was record in treatment D_1, *i.e.* embedded drying in silica gel whereas significantly minimum score (0.55,0.33 and 0.44) was found in treatment D_4 during the years 2013-14, 2014-15 and pooled data, respectively. As per cultivars, data on colour fading of dried Dutch rose flowers was non-significant during the year 2013-14, 2014-15 and pooled analysis.

Similar results were also observed by Gouin, 1994 [4], who reported that, dried materials should be stored in a dark, dry airtight container. A layer of tissue paper should be placed between flowers to reduce breakage. Spraying the dried flowers with a clear plastic spray will prevent them from absorbing water during humid periods and prevent dust from sticking and discoloring the petals

Bhutani (1995) [3] also suggested that, silica gel crystals should be kept at the bottom of the storage containers like desiccators, glass jars or plastic jars to prevent the dried plant material from spoilage and for their future utilization. Safeena (2005) [8]. Among the two conditions of storage, flowers stored without any lining recorded higher scores with respect to retention of colour on storage. This is because inserting in polythene covers caused moisture build up and it ruined the flowers. Here fading occurred as a result of the dried flower reabsorbing moisture. With respect to cultivars, the orange coloured cultivar 'Tropical Amazon' retained the colour for long time followed by Gold strike'.

Table 1: Effect of drying methods and cultivars on colour fading of dried Dutch rose flowers during storage at 30,60, and 90

Treatment	30 days			60 days			90 days		
	13-14	14-15	Pooled	13-14	14-15	Pooled	13-14	14-15	Pooled
Drying Methods (D)									
D_1	3.54	3.51	3.54	3.47	3.48	3.47	3.29	3.28	3.29
D_2	3.39	3.42	3.41	3.46	3.20	3.33	3.23	3.10	3.17
D_3	3.41	3.34	3.37	3.36	3.19	3.27	3.21	2.99	3.10
D_4	3.54	3.37	3.46	3.40	3.17	3.08	3.09	3.10	3.09
S.E m±	0.02	0.03	0.03	0.03	0.02	0.06	0.03	0.03	0.05
C.D. at 1%	NS	NS	NS	NS	NS	NS	0.10	0.09	0.15
Cultivar's (C)									
C_1	3.41	3.37	3.39	3.36	3.14	3.25	3.19	3.04	3.11
C_2	3.51	3.53	3.51	3.45	3.42	3.43	3.25	3.30	3.27
C_3	3.49	3.38	3.44	3.45	3.22	3.33	3.18	3.01	3.09
S.E m±	0.02	0.02	0.03	0.02	0.02	0.05	0.03	0.03	0.04
C.D. at 1%	NS	NS	NS	NS	NS	NS	NS	0.09	0.13
Interaction (D x C)									
D_1 C_1	3.51	3.37	3.44	3.43	3.19	3.31	3.15	3.00	3.07
D_2 C_1	3.47	3.52	3.50	3.58	3.36	3.47	3.34	3.20	3.27
D_3 C_1	3.45	3.31	3.38	3.39	3.17	3.28	3.13	2.98	3.05
D_4 C_1	3.54	3.33	3.43	3.41	3.14	3.27	3.15	3.00	3.07
D_1 C_2	3.64	3.63	3.64	3.53	3.63	3.58	3.36	3.53	3.44
D_2 C_2	3.33	3.48	3.40	3.51	3.26	3.39	3.22	3.07	3.14
D_3 C_2	3.42	3.32	3.37	3.36	3.19	3.28	3.18	3.03	3.11
D_4 C_2	3.65	3.62	3.63	3.40	3.60	3.50	3.24	3.16	3.40
D_1 C_3	3.46	3.62	3.54	3.44	3.62	3.53	3.37	3.32	3.34
D_2 C_3	3.37	3.26	3.32	3.28	2.99	3.13	3.15	3.03	3.09
D_3 C_3	3.35	3.41	3.38	3.34	3.20	3.27	3.32	2.97	3.15
D_4 C_3	3.44	3.18	3.31	3.39	2.76	3.08	2.88	2.73	2.80
S.E m±	0.05	0.05	0.06	0.05	0.04	0.11	0.06	0.06	0.08
C.D. at 1%	NS	NS	NS	NS	NS	NS	0.18	0.19	0.24
	Treatment details								
D_1-Embedded drying in silica gel									
D_2-Cabinet oven dryer at 40 ^{0}C + silica gel							C_1- Bordo		
D_3-2.5 M in microwave oven + silica gel							C_2- Tropical Amazon		
D_4-(-80 ^{0}C) for 12 h in cryopreservation							C_3-GoldStrike		

Table 2: Effect of drying methods and cultivars on colour fading of dried Dutch rose flowers during storage at 120,150, and 180

Treatment	120 days			150 days			180 days		
	13-14	14-15	Pooled	13-14	14-15	Pooled	13-14	14-15	Pooled
Drying Methods (D)									
D_1	3.10	3.16	3.13	2.40	2.50	2.45	1.69	1.49	1.59
D_2	3.13	3.04	3.09	2.34	2.26	2.30	1.43	1.33	1.38
D_3	3.05	2.90	2.98	2.26	2.19	2.22	1.33	1.27	1.30
D_4	1.85	1.96	1.90	1.73	1.71	1.72	0.55	0.33	0.44
S.E m±	0.03	0.03	0.05	0.03	0.03	0.02	0.04	0.06	0.05
C.D. at 1%	0.09	0.10	0.15	0.10	0.10	0.08	0.12	0.17	0.16
Cultivar's (C)									
C_1	3.01	2.93	2.96	1.82	1.77	1.79	1.40	1.29	1.35
C_2	3.11	3.17	3.14	1.86	2.08	1.87	1.35	1.29	1.32
C_3	3.00	2.95	2.97	1.55	1.72	1.73	1.33	1.27	1.30
S.E m±	0.02	0.03	0.04	0.03	0.03	0.02	0.13	0.15	0.14
C.D. at 1%	0.08	0.09	0.13	0.09	0.09	0.07	NS	NS	NS
Interaction (D x C)									
D_1 C_1	2.99	3.45	3.22	2.38	2.33	2.35	1.37	1.46	1.41
D_2 C_1	3.28	3.22	3.24	2.48	2.50	2.49	1.59	1.51	1.55
D_3 C_1	2.91	2.85	2.88	2.25	2.13	2.19	1.29	1.28	1.29
D_4 C_1	1.75	1.69	1.72	0.66	0.62	0.64	0.36	0.91	1.14
D_1 C_2	3.20	3.30	3.25	2.42	2.59	2.51	1.48	1.43	1.45
D_2 C_2	3.12	2.97	3.05	2.36	2.28	2.32	1.54	1.37	1.45
D_3 C_2	3.13	2.95	3.04	2.23	2.18	2.20	1.50	1.38	1.44
D_4 C_2	2.05	1.98	2.01	0.93	0.96	0.94	0.29	0.18	0.24
D_1 C_3	3.07	3.19	3.13	2.42	2.43	2.42	1.63	1.60	1.61
D_2 C_3	3.00	2.94	2.97	2.18	2.01	2.09	1.17	1.10	1.14
D_3 C_3	3.11	2.92	3.01	2.29	2.25	2.27	1.21	1.14	1.17
D_4 C_3	1.81	1.74	1.77	1.11	1.07	1.09	0.13	0.25	0.19
S.E m±	0.03	0.06	0.08	0.06	0.06	0.05	0.17	0.13	0.15
C.D. at 1%	0.09	0.18	0.24	0.18	0.18	0.15	NS	NS	NS
Treatment details									
D_1-Embedded drying in silica gel									
D_2-Cabinet oven dryer at 40 ^{0}C + silica gel							C_1- Bordo		
D_3-2.5 M in microwave oven + silica gel							C_2- Tropical Amazon		
D_4-(-80 ^{0}C) for 12 h in cryopreservation							C_3-GoldStrike		

Damage of dried flowers during Storage

Data pertaining to damage of dried Dutch rose flowers presented in Table 3 and 4. Significant differences were not observed among drying methods, cultivars and their interactions at 30, 60 and 90 days after storage.

At 120 days, data regarding damage of Dutch rose flowers during storage as influenced by drying methods was found to be significant. Significantly maximum sensory points (3.04) were recorded in treatment D_2, while minimum score (2.57) was found in treatment D_4 during the year 2013-14.

In the year, 2014-15 data was found to be non-significant regarding damage of dried rose flowers as influenced by drying methods. The pooled result also shows that, significantly maximum sensory score (3.00) was recorded by treatment D_2 which was at par with treatment D_1 (2.94) and minimum (2.68) was found in treatment D_4.

As regards the cultivars, there was non-significant effect on damage of dry flowers during the years 2013-14, 2014-15 and pooled result of experimentation. The interaction effect of drying method and cultivars was found to be significant during the year 2013-14. Significantly maximum score (3.16) was recorded in treatment combination D_2C_1 which was at par with treatment combinations D_2C_2 (3.15), D_1C_1 (3.07), D_1C_2 (3.06) and D_3C_1(3.05), while minimum score (1.43) was observed in treatment combination D_4C_2.

Similarly during the year 2014-15 maximum score (3.07) found in treatment combination D_2C_2 which was at par with treatment combinations of D_2C_3 (3.04), D_1C_1 (2.99), D_1C_2 (2.96) D_3C_1 (2.93) and minimum score (1.44) was found in D_4C_2. In pooled analysis, similar trend was also found regarding damage of dried flowers. Significantly maximum score (3.11) was found in treatment combination D_2C_2, which was at par with treatment combinations of D_2C_1 (3.09), DC_1 (3.03) D_1C_2 (3.01), D_3C_1 (2.99) and minimum score (1.41) was found in D_4C_3.

At 150 days, significantly maximum points (2.25) for damage of dry flower was recorded in treatment D_1, which was at par with treatment D_2 (2.24), while minimum sensory score (1.05) was observed in treatment D_4 during the year 2013-14. Significantly maximum score (2.13) was also, observed in treatment D_1 which was at par with treatment D_2 (2.08), while minimum score (1.08) was found in treatment D_4 in the year 2014-15 of experimentation. In pooled result, similar trend was also observed. Significantly maximum points (2.18) were recorded in treatment D_1, which was at par with treatment D_2 (2.16) and minimum points (1.02) in treatment D_4.

However**,** effect of cultivars and interaction on damage of dried flowers was found to be non-significant during the years 2013-14, 2014-15 and in pooled analysis.

At 180 days after storage significantly maximum score (1.52) was recorded in treatment D_1, while it was found minimum (0.93) in treatment D_4 during the year 2013-14. Highest sensory score (1.32) was observed in treatment D_3 which was at par with treatment D_1 (1.31), while least score (0.73) was observed in treatment D_4 during the year 2014-15. The pooled result shows that, significantly maximum score (1.41) was recorded in treatment D_1, which was at par with treatment D_3 (1.39) and minimum sensory score (0.88) for damage of dry flowers during storage was observed in treatment D_4.

Among the cultivars, significant effect was observed on

damage of dry Dutch rose flowers during storage in the years 2013-14, 2014-15 and pooled data. Significantly maximum score (1.43) was recorded by Bordo while minimum (1.28) was observed in Gold strike during the year 2013-14. Similarly, in the year 2014-15, highest score for damage (1.26) was found in cultivar C_1 which was statistically at par with Tropical Amazon and lowest (0.99) was observed in treatment C_3. In pooled result similar trend was also found during storage. Significantly maximum score of (1.34) was recorded in treatment C_1 which was at par with treatment C_2 (1.32), while least score was observed in treatment C_3 (1.13).

The interaction of drying methods and cultivars on damage of dry flowers was found to be non-significant during the years 2013-14, 2014-15 and pooled data of experimentation. These results are in accordance with the findings of Smith (1993) [9]. 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) [7] 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) [8] during his work

Table 3: Effect of drying methods and cultivars on damage of dried Dutch rose flowers during storage at 30,60, and 90

Treatment	30 days			60 days			90 days		
	13-14	14-15	Pooled	13-14	14-15	Pooled	13-14	14-15	Pooled
Drying Methods (D)									
D_1	3.38	3.38	3.38	3.30	3.21	3.26	3.21	3.13	3.17
D_2	3.35	3.35	3.35	3.31	3.18	3.24	3.25	3.17	3.21
D_3	3.32	3.40	3.36	3.22	3.16	3.16	3.10	3.09	3.09
D_4	3.29	3.41	3.35	3.17	3.16	3.11	3.03	3.07	3.05
S.E m±	0.05	0.03	0.02	0.04	0.05	0.02	0.04	0.04	0.03
C.D. at 1%	NS	NS	NS	NS	NS	NS	NS	NS	NS
Cultivar's (C)									
C_1	3.32	3.40	3.36	3.29	3.19	3.24	3.23	3.13	3.18
C_2	3.34	3.37	3.36	3.28	3.17	3.23	3.16	3.13	3.14
C_3	3.36	3.38	3.37	3.18	3.04	3.11	3.06	3.08	3.07
S.E m±	0.04	0.03	0.02	0.03	0.04	0.02	0.04	0.03	0.04
C.D. at 1%	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction (D x C)									
D_1 C_1	3.30	3.29	3.30	3.29	3.26	3.28	3.20	3.11	3.15
D_2 C_1	3.33	3.43	3.38	3.27	3.18	3.22	3.25	3.15	3.20
D_3 C_1	3.30	3.40	3.35	3.29	3.16	3.22	3.21	3.11	3.16
D_4 C_1	3.33	3.47	3.40	3.31	3.16	3.23	3.27	3.16	3.21
D_1 C_2	3.39	3.39	3.39	3.26	3.28	3.27	3.22	3.09	3.15
D_2 C_2	3.36	3.36	3.36	3.46	3.24	3.35	3.38	3.28	3.33
D_3 C_2	3.30	3.38	3.34	3.18	3.08	3.13	3.02	3.10	3.06
D_4 C_2	3.30	3.38	3.34	3.24	3.10	3.17	3.02	3.07	3.04
D_1 C_3	3.45	3.45	3.45	3.37	3.10	3.23	3.23	3.18	3.20
D_2 C_3	3.37	3.27	3.32	3.21	3.09	3.15	3.13	3.09	3.11
D_3 C_3	3.37	3.43	3.40	3.20	3.03	3.11	3.06	3.06	3.06
D_4 C_3	3.26	3.39	3.32	2.95	2.94	2.94	2.81	2.99	2.90
S.E m±	0.04	0.06	0.03	0.07	0.09	0.04	0.07	0.07	0.04
C.D. at 1%	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Treatment details								
D_1-Embedded drying in silica gel									
D_2-Cabinet oven dryer at 40 ^{0}C + silica gel							C_1- Bordo		
D_3-2.5 M in microwave oven + silica gel							C_2- Tropical Amazon		
D_4-(-80 ^{0}C) for 12 h in cryopreservation							C_3-GoldStrike		

Table 4: Effect of drying methods and cultivars on damage of dried Dutch rose flowers during storage at 120,150, and 180

Treatment	120 days			150 days			180 days		
	13-14	14-15	Pooled	13-14	14-15	Pooled	13-14	14-15	Pooled
Drying Methods (D)									
D_1	2.96	2.92	2.94	2.25	2.13	2.18	1.52	1.31	1.41
D_2	3.04	2.96	3.00	2.24	2.08	2.16	1.47	1.27	1.37
D_3	2.93	2.83	2.88	2.15	1.98	2.07	1.47	1.32	1.39
D_4	1.57	1.79	1.68	1.05	1.08	1.02	0.93	0.73	0.88
S.E m±	0.03	0.04	0.04	0.03	0.04	0.02	0.02	0.03	0.04
C.D. at 1%	0.11	NS	0.14	0.09	0.13	0.07	0.06	0.10	0.12
Cultivar's (C)									
C_1	2.96	2.97	2.96	2.18	2.01	2.09	1.43	1.26	1.34
C_2	2.87	2.89	2.88	2.14	2.02	2.08	1.41	1.22	1.32
C_3	2.79	2.78	2.78	1.96	1.87	1.92	1.28	0.99	1.13
S.E m±	0.05	0.03	0.03	0.02	0.03	0.03	0.02	0.03	0.03

C.D. at 1%	NS	NS	NS	NS	NS	NS	0.06	0.09	0.10
Interaction (D x C)									
$D_1 C_1$	3.07	2.99	3.03	2.25	2.07	2.16	1.62	1.42	1.52
$D_2 C_1$	3.16	3.04	3.09	2.34	2.24	2.29	1.51	1.26	1.38
$D_3 C_1$	3.05	2.93	2.99	2.28	2.06	2.17	1.59	1.42	1.50
$D_4 C_1$	1.59	1.91	1.75	1.06	1.07	1.06	0.95	0.93	0.94
$D_1 C_2$	3.06	2.96	3.01	2.34	2.21	2.57	1.56	1.37	1.46
$D_2 C_2$	3.15	3.07	3.11	2.33	2.14	2.23	1.54	1.35	1.45
$D_3 C_2$	2.85	2.78	2.81	2.16	2.08	2.12	1.48	1.34	1.41
$D_4 C_2$	1.43	1.45	1.44	1.02	1.08	1.07	1.01	0.94	0.97
$D_1 C_3$	2.76	2.82	2.79	2.15	2.11	2.13	1.40	1.14	1.27
$D_2 C_3$	2.83	2.77	2.80	2.05	1.87	1.96	1.35	1.19	1.27
$D_3 C_3$	2.89	2.78	2.83	2.01	1.81	1.91	1.34	1.21	1.27
$D_4 C_3$	1.45	1.44	1.41	1.01	1.02	1.08	0.95	0.61	0.73
S.E m±	0.06	0.07	0.08	0.05	0.07	0.04	0.04	0.06	0.07
C.D. at 1%	0.19	0.21	0.24	NS	NS	NS	NS	NS	NS
	Treatment details								
D_1-Embedded drying in silica gel									
D_2-Cabinet oven dryer at 40 ^{0}C + silica gel							C_1- Bordo		
D_3-2.5 M in microwave oven + silica gel							C_2- Tropical Amazon		
D_4-(-80 ^{0}C) for 12 h in cryopreservation							C_3-GoldStrike		

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