



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; SP-9(5): 325-330
Received: xx-03-2026
Accepted: xx-04-2026

Yogeshwari

M.Sc., Department of Floriculture
and Landscaping, Krantikari
Debridhur College of Horticulture
and Research Station, Jagdalpur,
Chhattisgarh, India

Sushil Kumar Kashyap

Assistant Professor, Department of
Floriculture and Landscaping,
College of Horticulture and
Research Station, Dhamtari,
Chhattisgarh, India

Eshu Sahu

Assistant Professor, Department of
Vegetable Science, College of
Horticulture and Research Station,
Sonarpal, Chhattisgarh, India

Ram Kumar Dewangan

Assistant Professor, Department of
Fruit Science, Krantikari
Debridhur College of Horticulture
and Research Station, Jagdalpur,
Chhattisgarh, India

Richa Sao

Assistant Professor, Department of
Genetics and Plant Breeding,
College of Horticulture and
Research Station, Sankra-Patan,
Durg, Chhattisgarh, India

Rinu

Department of Floriculture and
Landscaping, Mahatma Gandhi
University of Horticulture and
Forestry, Durg, Chhattisgarh,
India

Corresponding Author:

Yogeshwari

M.Sc., Department of Floriculture
and Landscaping, Krantikari
Debridhur College of Horticulture
and Research Station, Jagdalpur,
Chhattisgarh, India

Studies of different drying methods on the quality parameter of Dutch rose

**Yogeshwari, Sushil Kumar Kashyap, Eshu Sahu, Ram Kumar Dewangan,
Richa Sao and Rinu**

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i5Sd.5591>

Abstract

A field experiment entitled “Studies of different drying methods on the quality parameter of Dutch rose” was conducted at the Research-Cum Instructional Lab of K.D. College of Horticulture and Research Station, Jagdalpur (C.G.) during summer season of 2024-25. The experiment was laid out in Completely Randomized Design with three replications. The treatments consisted of fifteen different drying practices viz., T₁ (Room drying without desiccant), T₂ (Room drying with silica gel), T₃ (Room drying with borax), T₄ (Room drying with sand), T₅ (Sun drying without desiccant), T₆ (Sun drying with silica gel), T₇ (Sun drying with borax), T₈ (Sun drying with sand), T₉ (Hot air oven drying at 40 °C without desiccant), T₁₀ (Hot air oven drying at 40 °C with silica gel), T₁₁ (Hot air oven drying at 40 °C with borax), T₁₂ (Hot air oven drying at 40 °C with sand), T₁₃ (Hot air oven drying at 45 °C with silica gel), T₁₄ (Hot air oven drying at 45 °C with borax) and T₁₅ (Hot air oven drying at 45 °C with sand). Observations on quality parameters of Dutch rose such as fresh weight of flower (g), dry weight of flower (g), moisture content% of flower, moisture loss% of flower, diameter of flower (cm) and reduction in flower diameter (cm), flower color, flower shape, flower quality, flower texture and flower Appearance were recorded and statistically analyzed. The study revealed that the hot air oven drying treatment T₁₃–Hot air oven drying at 45 °C with silica gel consistently produced the best results across all flower quality parameters of Dutch rose, which was statistically at par with T₁₄ (Hot air oven drying at 45 °C with borax) and T₁₅ (Hot air oven drying at 45 °C with sand). These treatments maintained maximum fresh (8.26 g) and dry weight (3.19 g), lowest residual moisture (61.40%) and highest flower diameter (4.12 cm) with minimal reduction (0.184 cm), intense dark yellow color, high-centered bloom shape and fine petal texture, resulting in the most attractive overall appearance. In contrast, room drying treatments, T₁ (without desiccant), T₂ (with silica gel), T₃ (with borax) and T₄ (with sand) exhibited the lowest flower weight, highest moisture content, greater shrinkage, duller coloration, cupped blooms and poorer petal texture, highlighting the inefficiency of slow ambient drying for maintaining ornamental and structural quality. Overall, hot air oven drying at 45 °C with silica gel (T₁₃) proved to be the most effective method for preserving Dutch rose flowers, ensuring superior quality and long-term storage potential.

Keywords: Dutch rose, silica gel, borax, sand, desiccant and hot air oven etc.

Introduction

The rose, often admired as the “Queen of Flowers,” is considered one of the most beautiful creations of nature. It is a member of the Rosaceae family and falls under the genus *Rosa*. Globally, nearly 120 *Rosa* species are identified, and nearly 30,000 cultivars are grown across different regions. Roses represent love, purity, admiration and hold significant importance in cultural, religious, and social practices around the world. Because of their beauty and growing customer preference, they occupy a major share of the international cut flower market. In India, roses are cultivated on a large scale for various uses, including cut flowers, floral decorations, gulkand, rose water, garlands, worship and perfumery (Vijayalaxmi *et al.*, 2017) ^[42]. Their dried petals are used to make potpourri, vinegar, and wine, while rose hips, which are rich in vitamin C, are processed into syrups, jams and jellies. Rose extracts are also extensively applied in the cosmetic and fragrance industries (Irshad *et al.*, 2020) ^[14].

Rose ranks as the leading cut flower in the global flower trade in terms of both production and consumption. It is highly valued for its remarkable diversity in shape, size, color and its pleasant

fragrance. Numerous value-added products can be created from dried rose flowers, including collages, floral artworks, flower balls, greeting cards, decorative covers, pomanders, festive ornaments, bouquets, wreaths and fragrant potpourri (Vishnupriya and Jawaharlal, 2014) [43].

In India, dried flower industry is as old as 40 years. But it is only the last decade that brought in a lot of changes and widened the scope of this industry. The momentum of growth was surprisingly high during the past 10 years (Kulkarni *et al.*, 2004) [16]. The life of dried flowers varies with different flowers according to the species, texture of their petals and total consistency of flowers. The United States is the largest consumer of dried and artificial flowers, with an estimated annual expenditure of US \$2.4 million, followed by Germany and the United Kingdom. Other major importing regions include Western Europe, Japan, Hong Kong and Singapore (Mishra *et al.*, 2014) [19]. India, endowed with a rich diversity of flora, acts as a key raw material supplier for the dried flower industry and holds the potential for a market value of approximately Rs. 40 million in this sector. One of the main advantages of dried flowers is their long-lasting beauty; they can be preserved for years, enduring both winter chills and summer heat. With increasing eco-consciousness, natural and sustainable decorative options like dried flowers are becoming a preferred choice. The longevity of dried flowers depends on their species, petal texture and structural integrity. These flowers can be effectively utilized in decorative floral crafts for interior decoration as well as for commercial purposes (Ranjan and Misra, 2002) [27]. To promote eco-friendly trade, the government provides a 25% rebate on freight for dried flower products. India exports substantial quantities of raw materials to developed countries such as the UK, Japan, and the USA, where there is a high demand for dried floral arrangements (Raju, 2001) [30].

Rose flowers are traded through a well-organized international market system, providing employment opportunities for numerous entrepreneurs worldwide. Floriculture has emerged as a highly profitable profession, offering greater returns than many traditional field and horticultural crops (Dilta *et al.*, 2011) [10]. In India, however, the export potential of the dried flower industry has largely been overlooked, and the sector remains one of the most neglected. The field holds immense prospects, and with sustained efforts, India can establish a significant presence in the global market. There is an urgent need to optimize flower drying techniques, taking into account the local flora and fauna and the prevailing climatic conditions in the country. Therefore, the present study was undertaken to standardize drying technology for Dutch roses. The quality of dried flowers is largely influenced by factors such as flower structure, moisture content, stage and time of harvest and the drying method employed. Therefore, the present study was conducted with the objective of evaluating the effects of variety, harvest stage and drying methods on the quality of dried flowers. Given the significant potential of Dutch roses in the dried flower industry, the present study was designed to determine the most effective drying method, the most suitable cultivar and the optimal drying duration using microwave, hot air oven, and air-drying techniques. Flowers, as natural symbols of human emotions, contribute greatly to aesthetic appeal and help create an eco-friendly environment. With the increasing global demand for flowers, the industry is experiencing rapid growth. However, fresh flowers are costly, highly perishable, and not available year-round in all regions (Datta, 2019). To ensure year-round availability and extend the longevity of flowers, drying is considered one of the most effective preservation methods.

Dried flowers retain their aesthetic appeal and are long-lasting regardless of season (Koley, 2020). Among cut flowers, Dutch rose is highly valued for its vibrant colour, uniform bloom, long stalk and excellent vase life, making it a top choice in both domestic and export markets.

Dutch roses are mainly grown under protected conditions, such as polyhouses, in states like Karnataka, Gujarat, West Bengal and Chhattisgarh to meet the high demand during special occasions, including Valentine's Day, Christmas and weddings. Protected cultivation helps reduce the effects of climate-related stresses, such as heat, drought and pest infestations, while ensuring consistent production of high-quality flowers. Although fresh roses are visually appealing, they are highly perishable and not available throughout the year. Drying offers a way to preserve their ornamental value and fulfill year-round decorative requirements. With increasing eco-consciousness, dried flowers are becoming more popular for home décor, crafts, and commercial products due to their natural beauty and long shelf life (Mahapati *et al.*, 2015) [18]. Considering the commercial significance of Dutch roses and the limitations in the availability of fresh flowers, the present study aims to evaluate different drying techniques microwave, hot air oven and air drying to produce high-quality dried Dutch rose flowers under naturally ventilated polyhouse conditions. The study also examines the performance of various cultivars in Karnataka's Northern dry zone, where high summer temperatures restrict rose cultivation (Datta, 2004; Datta *et al.*, 2007) [12, 11].

Materials and Methods

A field experiment entitled "Studies of different drying methods on the quality parameter of Dutch rose" was conducted at the Research-Cum Instructional Lab of K.D. College of Horticulture and Research Station, Jagdalpur (C.G.) during summer season of 2024-25. The experiment was laid out in Completely Randomized Design with three replications. The treatments consisted of fifteen different drying practices viz., T₁ (Room drying without desiccant), T₂ (Room drying with silica gel), T₃ (Room drying with borax), T₄ (Room drying with sand), T₅ (Sun drying without desiccant), T₆ (Sun drying with silica gel), T₇ (Sun drying with borax), T₈ (Sun drying with sand), T₉ (Hot air oven drying at 40 °C without desiccant), T₁₀ (Hot air oven drying at 40 °C with silica gel), T₁₁ (Hot air oven drying at 40 °C with borax), T₁₂ (Hot air oven drying at 40 °C with sand), T₁₃ (Hot air oven drying at 45 °C with silica gel), T₁₄ (Hot air oven drying at 45 °C with borax) and T₁₅ (Hot air oven drying at 45 °C with sand). Observations on quality parameters of Dutch rose such as fresh weight of flower (g), dry weight of flower (g), moisture content% of flower, moisture loss% of flower, diameter of flower (cm) and reduction in flower diameter (cm), flower color, flower shape, flower quality, flower texture and flower Appearance were recorded and statistically analyzed.

Results and Discussion

Flower Quality Parameters

1. Flower weight (fresh and dry)

The maximum fresh weight (8.26 g) and dry weight (3.19 g) of Dutch rose flowers were recorded under T₁₃ (Hot air oven drying at 45 °C with silica gel), followed closely by T₁₄ (Hot air oven drying at 45 °C with borax). Treatment T₁₀ (Hot air oven drying at 40 °C with silica gel) and T₁₁ (Hot air oven drying at 40 °C with borax) produced moderate flower weights, whereas T₆ (Sun drying with silica gel) maintained intermediate weight values. The lowest fresh and dry weights were observed in T₁ (Room drying without desiccant), likely due to slow moisture loss

leading to excessive shrinkage and petal damage.

2. Moisture content (%)

Room drying treatments retained the highest residual moisture, indicating slow dehydration, which could lead to microbial growth. T₁₃ (Hot air oven drying at 45 °C with silica gel) showed the lowest moisture content, suggesting rapid and uniform water removal, which is crucial for long-term preservation. Sun drying (T₆) and oven drying at 40 °C resulted in intermediate moisture levels, indicating partial dehydration but not as efficient as 45 °C with desiccants.

3. Moisture loss (%)

The moisture loss was significantly influenced by different drying methods and use of desiccants. Among all treatments, the highest moisture loss was recorded in T₁ (Room drying without desiccant, 66.67%), which was statistically at par with T₂ (Room drying with silica gel, 65.64%), T₃ (Room drying with borax, 65.80%), and T₄ (Room drying with sand, 65.87%). The lowest moisture loss was observed in hot air oven drying at 45 °C, particularly T₁₃ (with silica gel, 61.40%), which was statistically at par with T₁₄ (with borax, 62.76%) and T₁₅ (with sand, 63.00%).

4. Flower diameter (cm)

The largest flower diameter was recorded in T₁₃ (Hot air oven drying at 45 °C with silica gel, 4.12 cm), which was statistically at par with T₁₄ (Hot air oven drying at 45 °C with borax, 4.02 cm) and T₁₅ (Hot air oven drying at 45 °C with sand, 3.98 cm). Room drying caused significant shrinkage with the smallest diameters (3.52 cm).

5. Reduction in flower diameter (cm)

The minimum reduction in flower diameter was recorded in T₁₃ (Hot air oven drying at 45 °C with silica gel, 0.184 cm), which was statistically at par with T₁₄ (Hot air oven drying at 45 °C with borax, 0.195 cm) and T₁₅ (Hot air oven drying at 45 °C with sand, 0.214 cm). Room drying treatments, including T₂ (with silica gel, 0.437 cm), T₃ (with borax, 0.455 cm), T₄ (with sand, 0.470 cm), and T₁ (without desiccant, 0.490 cm), recorded the highest reductions in flower diameter, indicating greater shrinkage under slow drying conditions.

6. Flower color

The results revealed that the most intense and desirable color was retained in T₁₃ (Hot air oven drying at 45 °C with silica gel), T₁₄ (Hot air oven drying at 45 °C with borax), and T₁₅ (Hot air oven drying at 45 °C with sand), all exhibiting dark yellow coloration. Room drying treatments, T₁ (without desiccant), T₂ (with silica gel), T₃ (with borax), and T₄ (with sand), exhibited bronze yellow to raisin yellow coloration.

7. Flower shape

The most desirable high-centered blooms were observed in T₁₃ (Hot air oven drying at 45 °C with silica gel), T₁₄ (Hot air oven drying at 45 °C with borax), and T₁₅ (Hot air oven drying at 45 °C with sand). These treatments were significantly superior to all other drying methods in maintaining the natural, aesthetic form of the flowers. Room drying treatments, including T₁ (without desiccant), T₂ (with silica gel), T₃ (with borax), and T₄ (with sand), produced cupped blooms, showing maximum distortion and shrinkage of petals due to slow and uneven moisture loss.

8. Petal texture and quality

Results revealed that the finest flower texture was recorded in T₁₃ (Hot air oven drying at 45 °C with silica gel), T₁₄ (Hot air oven drying at 45 °C with borax), and T₁₅ (Hot air oven drying at 45 °C with sand), which were rated as fine texture.

9. Overall appearance

The appearance of flowers was significantly influenced by different drying methods. The most attractive and bright flowers were observed in T₁₃ (Hot air oven drying at 45 °C with silica gel), T₁₄ (Hot air oven drying at 45 °C with borax), and T₁₅ (Hot air oven drying at 45 °C with sand), which were rated as having more bright colour. Resulted in moderate colour fading, while room drying treatments T₁ (without desiccant), T₂ (with silica gel), T₃ (with borax), T₄ (with sand) produced flowers with dull or more faded colours, reflecting significant pigment degradation due to prolonged drying at ambient conditions.



Freshly harvested flowers



Silica gel drying, Borax drying



Initial and dry diameter observation of flower



weight of the flower



Hot air oven drying



Dry flowers

Table 1: Effect of different drying methods on different parameters of Dutch rose

Treatment details	Days/hours	Flower weight (g)		Moisture content % in flower	Moisture loss % of flower	Diameter of flower (cm)	Reduction in flower diameter (cm)
		Fresh weight	Dry weight				
T ₁ - Room drying without desiccant	5 Days	7.10	2.47	65.21	66.67	2.42	0.490
T ₂ - Room drying with silica gel	5 Days	7.19	2.54	64.67	65.64	2.73	0.437
T ₃ - Room drying with borax	5 Days	7.15	2.52	64.75	65.80	2.87	0.455
T ₄ - Room drying with sand	5 Days	7.12	2.50	64.88	65.87	3.02	0.470
T ₅ - Sun drying without desiccant	5 Days	7.42	2.82	61.99	62.00	3.29	0.354
T ₆ - Sun drying with silica gel	5 Days	7.53	2.88	61.75	61.73	3.50	0.336
T ₇ - Sun drying with borax	5 Days	7.49	2.86	61.81	61.87	3.42	0.311
T ₈ - Sun drying with sand	5 Days	7.44	2.83	61.96	63.13	3.35	0.252
T ₉ - Hot air oven drying at 40 °C without desiccant	24 hrs.	7.87	2.99	62.00	62.00	3.76	0.268
T ₁₀ - Hot air oven drying at 40 °C with silica gel	24 hrs.	7.98	3.03	62.03	63.00	3.88	0.280
T ₁₁ - Hot air oven drying at 40 °C with borax	24 hrs.	7.95	3.01	62.13	64.14	3.84	0.287
T ₁₂ - Hot air oven drying at 40 °C with sand	24 hrs.	7.91	2.98	62.32	64.33	3.80	0.329
T ₁₃ - Hot air oven drying at 45 °C with silica gel	24 hrs.	8.26	3.19	61.38	61.40	4.12	0.184
T ₁₄ - Hot air oven drying at 45 °C with borax	24 hrs.	8.24	3.15	61.77	62.76	4.02	0.195
T ₁₅ - Hot air oven drying at 45 °C with sand	24 hrs.	8.21	3.12	61.99	63.00	3.98	0.214
SEm (±)		0.15	0.08	1.016	0.98	0.07	0.005
CD (5%)		0.43	0.23	2.948	2.83	0.19	0.014

Table 2: Effect of different drying methods on flower color, flower shape, flower quality, flower texture and flower appearance of Dutch rose

Treatment details	Days/hours	Flower color	Flower shape	Flower quality	Flower texture	Flower appearance
T ₁ - Room drying without desiccant	5 Days	Bronze yellow	Cupped blooms	Poor	Rough texture	Dull colour
T ₂ - Room drying with silica gel	5 Days	Rasin yellow	Cupped blooms	Poor	Slightly rough	More colour fading
T ₃ - Room drying with borax	5 Days	Rasin yellow	Cupped blooms	Poor	Slightly rough	More colour fading
T ₄ - Room drying with sand	5 Days	Rasin yellow	Cupped blooms	Poor	Slightly rough	More colour fading
T ₅ - Sun drying without desiccant	5 Days	Rosewood yellow	Globular blooms	Good	Medium texture	Colour fading
T ₆ - Sun drying with silica gel	5 Days	Rosewood yellow	Globular blooms	Good	Medium texture	Colour fading
T ₇ - Sun drying with borax	5 Days	Rosewood yellow	Globular blooms	Good	Medium texture	Colour fading
T ₈ - Sun drying with sand	5 Days	Rosewood yellow	Globular blooms	Good	Medium texture	Colour fading
T ₉ - Hot air oven drying at 40 °C without desiccant	24 hrs.	Wine yellow	Globular blooms	Very good	Slightly coarse	Bright colour
T ₁₀ - Hot air oven drying at 40 °C with silica gel	24 hrs.	Wine yellow	Globular blooms	Very good	Slightly coarse	Bright colour
T ₁₁ - Hot air oven drying at 40 °C with borax	24 hrs.	Wine yellow	Globular blooms	Very good	Slightly coarse	Bright colour
T ₁₂ - Hot air oven drying at 40 °C with sand	24 hrs.	Wine yellow	Globular blooms	Very good	Slightly coarse	Bright colour
T ₁₃ - Hot air oven drying at 45 °C with silica gel	24 hrs.	Dark yellow	High centered blooms	Excellent	Fine texture	More Bright colour
T ₁₄ - Hot air oven drying at 45 °C with borax	24 hrs.	Dark yellow	High centered blooms	Excellent	Fine texture	More Bright colour
T ₁₅ - Hot air oven drying at 45 °C with sand	24 hrs.	Dark yellow	High centered blooms	Excellent	Fine texture	More Bright colour

Conclusion

The study revealed that the hot air oven drying treatment T₁₃ (Hot air oven drying at 45 °C with silica gel) consistently produced the best results across all flower quality parameters of Dutch rose, which was statistically at par with T₁₄ (Hot air oven drying at 45 °C with borax) and T₁₅ (Hot air oven drying at 45 °C with sand). These treatments maintained maximum fresh (8.26 g) and dry weight (3.19 g), lowest residual moisture (61.40%) and highest flower diameter (4.12 cm) with minimal reduction (0.184 cm), intense dark yellow color, high-centered bloom shape and fine petal texture, resulting in the most attractive overall appearance. In contrast, room drying treatments T₁ (without desiccant), T₂ (with silica gel), T₃ (with borax) and T₄ (with sand) exhibited the lowest flower weight, highest moisture content, greater shrinkage, duller coloration, cupped blooms and poorer petal texture, highlighting the inefficiency of slow ambient drying for maintaining ornamental and structural quality. Overall, hot air oven drying at 45 °C with silica gel T₁₃ proved to be the most effective method for preserving Dutch rose flowers, ensuring superior quality and long-term storage potential.

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