



Optimizing Substrate Composition for Enhanced Growth and Corm Development in *Freesia hybrida* under Sub-Tropical Conditions of Punjab

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Abstract: *Freesia hybrida*, a specialty cut flower, is primarily cultivated in India in the cooler climates of the Western Ghats, the Nilgiri Hills, and certain Himalayan regions. However, the sandy soils prevalent in many Indian plains present challenges such as poor water retention and low fertility. This necessitates developing tailored potting media for optimal *Freesia* cultivation. This study investigated the influence of various growing media on the growth, flowering, and corm development of *F. hybrida* under controlled conditions for two consecutive years (2022–2023 and 2023–2024). A total of seven treatments consisting of different combinations of cocopeat, farmyard manure (FYM), perlite, vermicompost, leaf mould, and rice husk were evaluated against control treatment (soil + FYM). Cocopeat-based treatments consistently outperformed the control across all measured parameters. The combination of cocopeat, FYM and perlite yielded the best overall performance, resulting in the tallest plants (31.14 cm), earliest flowering (105.35 days), longest flowering duration (20.85 days), and largest, heaviest corms. The findings emphasize the importance of using improved soilless media, particularly cocopeat enriched with FYM and perlite, for optimizing freesia cultivation in the sub-tropical regions of Punjab.

Keywords: *Freesia hybrida*, Potting media, Cocopeat, Farmyard manure, Perlite

Freesia (Freesia hybrida), a valued ornamental plant of the Iridaceae family, is known for its vibrant colours, fragrant blooms, and elegant appearance. Native to South Africa and named after German botanist Friedrich Heinrich Theodor Freese in 1830. *Freesia* is now cultivated across the globe. In India, it is primarily grown in the cooler regions of the Western Ghats, Nilgiri Hills, and parts of the Himalayas, where favourable climatic conditions support its optimal growth and flowering. The success of freesia cultivation, particularly in containers or non-traditional growing areas, is largely influenced by the quality of potting media, which affects root development, nutrient uptake, moisture retention, and overall plant health. However, sandy soils commonly available in many parts of India, pose significant limitations due to their poor water-holding capacity, low organic matter content and limited nutrient availability (Herawati et al., 2021). To address these challenges, incorporating organic and inorganic amendments into potting media has proven effective in improving soil structure and fertility. Organic composts and soil conditioners enhance water retention, aeration and microbial activity (Thakur et al. (2023), thereby supporting healthier and more vigorous plant growth, and improve soil fertility and structure (Chauhan, 2014). Given these limitations, there is a pressing need to develop customized potting media tailored to the specific requirements of *Freesia hybrida*, especially in sub-tropical regions of Punjab. Hassan et al. (2025) emphasized that the choice of growing media

significantly influences freesia's vegetative and reproductive performance. Therefore, this study aims to evaluate the impact of various potting media compositions on the growth, flowering, and corm development of *Freesia hybrida*. The findings will provide valuable insights for optimizing cultivation practices, enhancing flower and corm quality, and promoting sustainable, cost-effective media options suitable for both commercial and small-scale growers.

MATERIAL AND METHODS

Experimental site: The present study on "Optimizing substrate composition for enhanced growth, flowering and corm development in *Freesia hybrida* in sub-tropical region of Punjab" was conducted at Punjab Agricultural University, Ludhiana, during the years 2022-2023 and 2023-2024. Ludhiana, located at 30.91° North latitude and 75.85° East longitude, experiences a subtropical climate with hot, humid summers and cold, frosty winters. The region's soil is predominantly sandy loam, with a slightly alkaline pH, low phosphorus content, but medium to high levels of potassium, nitrogen, and organic carbon, making it suitable for ornamental plant cultivation. The aim of this experiment was to evaluate the impact of various potting media on the growth and flowering characteristics of *Freesia hybrida* under nursery-based growing conditions.

Treatment details: Completely randomized design was employed with seven different potting media treatments,

replicated three times. The treatments tested in the study were: T1 – Soil + FYM (1:1) (Control), T2 – Cocopeat + FYM + Perlite (2:1:1), T3 – Cocopeat + Leaf mould + Perlite (2:1:1), T4 – Cocopeat + Vermicompost + Perlite (2:1:1), T5 – Cocopeat + FYM + Rice husk (2:1:1), T6 – Cocopeat + Leaf mould + Rice husk (2:1:1), and T7 – Cocopeat + Vermicompost + Rice husk (2:1:1). The experiment involved planting *Freesia* corms sourced from Delhi, which were placed in 15 cm pots filled with the respective media. The observations were recorded for various growth, flowering and corm parameters. The cocopeat bricks used in the media treatments were soaked in water for one day before being mixed with the other components. Organic amendments such as vermicompost, FYM and leaf mould were collected from the Floriculture Research Farm and prepared using standard composting procedures.

Statistical analysis: Statistical analysis was performed using SAS software version 9.0.

RESULTS AND DISCUSSION

The growth attributes of *Freesia hybrida* were significantly influenced by the various potting media combinations (Table 1). Treatment T2, consisting of cocopeat + FYM + perlite (2:1:1), demonstrated superior performance across all parameters, including the highest plant height (47.5 cm), shortest number of days to flowering (105.35 days), largest flower diameter (5.12 cm), longest flowering duration (20.85 days), highest final corm weight (5.76 g) and the largest final corm diameter (23.59 mm).

In comparison, the control treatment (T1), consisting of soil + FYM (1:1), recorded the lowest values across these parameters. T4 (cocopeat + FYM + perlite) and other combinations like T5, T6, and T7 showed intermediate results, with T4 performing better in most growth and flowering parameters. Overall, T2 consisting of cocopeat + FYM + perlite (2:1:1), proved to be the most effective potting medium, significantly enhancing the growth and flowering

attributes of *Freesia hybrida*. The enhanced plant height observed in these media combinations can be attributed to the high nutrient content, optimal porosity and aeration, which allowed better root development and nutrient uptake. This aligns with the previous research findings, which have consistently highlighted the positive impact of cocopeat, especially when combined with organic amendments like vermicompost or FYM, on plant growth (Moghadam et al., 2012).

Higher leaf numbers per plant in T2 and T4 contributed to increased carbohydrate reserves, which promoted quicker transition from vegetative to reproductive growth stages, thus leading to earlier flowering. Seyedi et al. (2012) also observed similar trend on various plant species, including liliium. Both T2 (cocopeat + FYM + perlite) and T4 (cocopeat + vermicompost + perlite) resulted in larger flower diameters, highlighting the significant role of the growing media in determining floral characteristics. Larger flowers are often associated with higher availability of photosynthates and optimal nutrient conditions, both of which were provided by the media combinations containing cocopeat, FYM, and vermicompost. The presence of these organic amendments enriched the media with essential nutrients such as nitrogen, potassium, and phosphorus, which are critical for flower development (Kala et al., 2020).

The duration of flowering was also significantly extended in T2 and T4, aligning with earlier studies that beneficial effects of cocopeat-based media on flower longevity (Cortes et al., 2011, Kameshwari et al., 2014). The increased corm weight in T2 and T4 supports findings on the positive effects of cocopeat and vermicompost on corm development in other bulbous crops (Moghadam et al., 2012, Rajera and Sharma, 2017).

Cocopeat is recognized for its high content of exchangeable and DTPA-extractable ions (Aswath and Pillai 2004). Studies have demonstrated that combining cocopeat with other organic materials, such as vermicompost and

Table 1. Effect of different growing media combinations on vegetative and flowering attributes of *Freesia hybrida* (Pooled data of year 2023-24)

Treatments	Plant height (cm)	Number of days to flowering	Flower diameter (cm)	Flowering duration (days)	Final corm weight (cm)	Final corm diameter (mm)
T1	22.01 e	124.43 d	4.16 b	12.68 f	3.81 c	18.57 e
T2	31.14 a	105.35 a	5.12 a	20.85 a	5.76 a	23.59 a
T3	23.23 b	122.48 d	4.29 b	13.99 de	4.08 c	20.24 cd
T4	28.75 ab	111.60 b	4.87 a	19.56 b	5.19 ab	22.21 b
T5	25.85 cd	116.07 c	4.38 b	15.62 cd	4.02 c	20.81 c
T6	24.99 d	117.56 c	4.18 b	14.98 de	3.58 c	19.05 de
T7	26.71 c	115.22 c	4.44 b	17.84 bc	4.54 bc	21.29 bc

Different letters in column indicate statistical differences at 5 percent

farmyard manure, significantly enhances plant growth and flowering in species like croton (Anjana et al., 2017) and tuberose (Nair et al., 2019). Additionally, mixing cocopeat with vermiculite, soil, or perlite has been shown to improve flowering characteristics in Liliium (Chaudhary et al., 2018). The higher nutrient content and better water retention of these media provided an environment conducive to nutrient uptake and storage in the corms, leading to heavier final corm weights. The diameter of the corms was also significantly larger in T2 and T4. The optimal conditions provided by these media likely promoted better corm development, with sufficient nutrients and adequate aeration. Nikrazm et al. (2011), also observed that cocopeat-based media significantly increased bulb size in Liliium.

CONCLUSION

The use of cocopeat-based growing media, particularly when combined with organic amendments like vermicompost and FYM, has a positive impact on several key parameters of plant growth, flowering, and corm development. The combination of cocopeat + FYM + perlite and cocopeat + vermicompost + perlite provided optimal conditions for plant height, early flowering, larger flower size, prolonged flowering duration, and increased corm weight and diameter. These findings underscore the importance of selecting appropriate growing media for optimizing plant growth and yield in bulbous crops.

AUTHORS' CONTRIBUTIONS

R K Dubey and Simrat Singh developed the concept of the experiment. Gururaj executed the trial and collected and analysed the data. Gururaj, R K Dubey, Kritika Pant and Uma Patel prepared the manuscript.

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