Scientific article

Corm and cormel production in *Freesia* × *hybrida* as a function of planting date

Producción de cormos y cormillos en *Freesia* × *hybrida* en función de la fecha de plantación

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Abstract

This study aimed to evaluate the effect of planting date on the production of corms and cormels in *Freesia* × *hybrida* in Tucumán, Argentina. The experiment was conducted in a high tunnel using a randomized complete block design with a factorial arrangement. Five dates were established, from February 15 to June 21, 2021, and two commercial cultivars, Blue Bayou and Yvonne, were evaluated. Growth variables related to storage organ development were measured: corm weight and diameter, number of cormels per plant, and average cormel weight. The results showed a significant interaction between cultivar and planting date for both corm weight and average cormel weight. Early planting dates (February and March) promoted the development of larger and heavier structures, while delayed planting progressively reduced the multiplication rate. Regardless of planting date, the Blue Bayou cultivar consistently produced corms with a larger diameter. It is concluded that proper management of planting date is a key factor for optimizing production efficiency and commercial propagation of *Freesia*.

Keywords: Corm yield; Geophytes; Iridaceae; Propagation efficiency.

Resumen

El objetivo de este trabajo fue evaluar el efecto de la fecha de plantación sobre la producción de cormos y cormillos de *Freesia* × *hybrida*, en Tucumán, Argentina. El ensayo se realizó en un túnel alto, utilizando un diseño de bloques completos al azar con arreglo factorial. Se establecieron cinco fechas de plantación, desde el 15 de febrero hasta el 21 de junio de 2021, y se evaluaron las variedades Blue Bayou e Yvonne. Se midieron variables de crecimiento de los órganos de almacenamiento: peso y diámetro del cormo, número de cormillos por planta y peso promedio de los cormillos. Los resultados evidenciaron una interacción significativa entre la variedad y la fecha de plantación para el peso del cormo y el peso promedio de los cormillos. Las fechas más tempranas (febrero y marzo) promovieron el desarrollo de estructuras de mayor tamaño y peso, mientras que el retraso en la plantación redujo progresivamente la tasa de multiplicación. Independientemente de la fecha, la variedad Blue Bayou se destacó por producir cormos de mayor diámetro. Se concluye que el manejo adecuado de la fecha de plantación constituye un factor clave para optimizar la eficiencia productiva y la propagación comercial de *Freesia*.

Palabras clave: Eficiencia de propagación; Geófitas; Iridaceae; Rendimiento de cormos.

Introduction

Freesia (*Freesia* × *hybrida* Klatt) belongs to the Iridaceae family; it is a monocotyledonous, herbaceous, perennial, and geophytic species native to the mountainous regions of South Africa (Mahmood *et al.*, 2023). It is cultivated as a cut flower and ranks among the ten most commercially traded cut flowers in the international market (Faust and Dole, 2021).

From a biological perspective, its propagation organ is a corm, a modified underground stem, that enables the plant to withstand adverse environmental conditions, ensures its

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multiplication (Pallotti *et al.*, 2024) and directly influences the quality and yield of the crop in subsequent cycles. After planting, the mother corm produces a new corm at its upper end and subsequently enters senescence and dies. The growth of the new corm occurs throughout the crop cycle and takes place simultaneously with leaf development, inflorescence emergence, flowering, and plant senescence. The new corm produces cormels at its base. Both structures are essential to ensure the propagation and continuity of the crop in future cycles (Santilli *et al.*, 2021).

Given their dual role in survival and multiplication, enhancing the development of corms and cormels is a critical goal in freesia production. Consequently, agronomic factors that influence these traits (particularly corm size) have attracted increasing attention. Corm size, defined by its diameter and weight, is a key trait in the production of flowers, corms, and cormels. In saffron (*Crocus sativus* L.), it has been demonstrated that larger corms significantly enhance the formation of daughter corms and flowering (Pallotti *et al.*, 2024). Similarly, in gladiolus (*Gladiolus* × *grandiflorus* Hort.), corm size has been reported to positively affect the productivity of flowers, corms, and cormels (Ahmed *et al.*, 2015; Hossain *et al.*, 2021; Nafees *et al.*, 2021; Amişculesei *et al.*, 2022; Kumari *et al.*, 2023).

Among the agronomic variables that influence corm development, planting date stands out as particularly decisive. Several studies in species of the Iridaceae family have shown that this variable influences corm size and the number of cormels produced per plant (Ahmad *et al.*, 2011; Kocira *et al.*, 2015; Amjad *et al.*, 2018; Fatihullah and Bostan, 2018; Ferdousi *et al.*, 2018; Amişculesei *et al.*, 2022; Yayğin *et al.*, 2022; Singh *et al.*, 2024).

In this context, the present study aimed to evaluate the response of two *F.* × *hybrida* varieties to different planting dates in terms of corm size and multiplication.

Materials and Methods

Experimental management

The experiment was conducted in a high tunnel located at (26º 50’ 6.9’’ S - 65º 16’ 44.6’’ W), on the experimental farm of the Facultad de Agronomía, Zootecnia y Veterinaria, Universidad Nacional de Tucumán (Tucumán, Argentina). The structure featured passive ventilation and was covered with 100-micron polyethylene film (high thermal persistence). The tunnel was oriented in a northwest - southeast direction. Corms of *F.* × *hybrida* from the varieties Blue Bayou (V1) and Yvonne (V2), with diameters ranging from 2.0 to 2.2 cm, were used. The plant material was obtained from a commercial supplier (FlorAr, Florencio Varela, Buenos Aires, Argentina) and propagated locally under the same high tunnel conditions during the previous production cycle. After harvest, the corms were stored at 25 °C until planting; storage time varied according to the planting date assigned to each treatment. This uniform propagation and storage ensured homogeneity across treatments.

The corms were planted in beds measuring 0.70 m in width, 0.20 m in height, and 4 m in length. The substrate consisted of previously solarized soil and agricultural perlite in a 3:1 ratio (vv^{-1}), with an electrical conductivity of 1.11 dS $m^{-1,}$ pH 6.4, organic matter content between 2.5 and 3.5%, and gravimetric moisture at field capacity of 66.8%.

Irrigation was applied by drip lines at regular intervals, using the gravimetric moisture at field capacity as a reference, with no water restrictions. Weeds were removed manually, and two horizontal support nets (mesh size: 0.125 m x 0.125 m) were installed per bed to support plant growth. A phytosanitary protection, lambda-cyhalothrin (400 cm^3 ha^{-1}) was applied once preventively during the early vegetative stage. No fertilization was applied during the experiment to isolate the effect of planting date on the variables studied.

Experimental design

The experiment followed a 2 x 5 factorial design (two varieties x five planting dates) arranged in a randomized complete block design with four replicates. Each replicate (block) included the 10 treatments (T1:V1D1, T2:V2D1, T3:V1D2, T4:V2D2, T5:V1D3, T6:V2D3, T7:V1D4, T8:V2D4, T9:V1D5, T10:V2D5) resulting from the combination of variety (V1: Blue Bayou; V2: Yvonne) and planting date (D1: February 15, D2: March 19, D3: April 16, D4: May 21, D5: June 21 of 2021), randomly distributed within each block.

Each experimental unit consisted of 18 corms.

Nine plants per replicate were randomly selected and evaluated individually, resulting in a total of 36 plants per treatment. Harvest was performed when all plants within a treatment reached foliar senescence (BBCH code 909), according to the morphological descriptors reported by Santilli *et al.* (2021).

Measured variables

- Corm weight (g): measured using an electronic balance (Ohaus TA501, New Jersey, USA).
- Corm diameter (mm): the equatorial diameter was measured using a digital caliper (Isard 88607, China).
- Number of cormels per corm: each cormel was counted manually per plant.
- Average cormel weight (g): determined by dividing the total fresh weight of all cormels produced by a plant by the corresponding number of cormels.

Environmental conditions

Environmental variables (mean, maximum, and minimum air temperature) were recorded throughout the crop cycle using a data logger (TPD8016, LogTag, New Zealand) placed inside the high tunnel. Daily photoperiod was calculated using the Varast 1.0 spreadsheet (Fernández-Long *et al.*, 2015). These data were not included in the statistical analysis but were used to characterize the environmental conditions corresponding to each planting date. This environmental characterization was previously published by our research group (Santilli *et al.*, 2023).

Statistical analysis

The data were analyzed using Infostat software version 2020 (Di Rienzo *et al.*, 2020). Analysis of variance (ANOVA) was performed to evaluate the effects of the factors and their interaction. Means were compared using the DGC multiple comparison test ($\alpha = 0.05$). The analyzed data met the assumptions of normality, homogeneity of variance, and independence.

Results and Discussion

A significant interaction was observed between planting date and variety for corm weight ($F = 3.71$; $df = 285$; $P < 0.0058$), indicating that the effect of planting date on this variable differed between cultivars (Table 1). Treatment T1 showed the highest value (19.43 ± 0.64 g) and differed significantly from the other treatments (Table 1). In contrast, treatments T8, T9, and T10 presented the lowest values: 5.25 ± 0.63 g, 5.35 ± 0.55 g, and 4.39 ± 0.61 g, respectively (Table 1). Similar results were reported by Ahmad *et al.* (2011), Ferdousi *et al.* (2018), and Singh *et al.* (2024) in gladiolus crop, where early planting dates promoted greater corm weight. Average cormel weight also showed a significant interaction between variety and planting date ($F = 3.33$; $df = 285$; $P = 0.0110$). Average weight decreased as planting was delayed. Treatments T1 to T5 recorded the highest values and differed significantly from the rest, while the lowest values corresponded to T8, T9, and T10 (Table 1). In gladiolus, Ahmad *et al.* (2011), Amjad *et al.* (2018), Fatihullah and Bostan (2018), and Yayğin *et al.* (2022) also reported that early planting dates favor higher cormel weight.

Corm diameter did not show a significant interaction between the factors analyzed ($F = 1.9$; $df = 285$; $P = 0.1110$). However, the effect of the variety factor was significant ($F = 92.23$; $df = 285$; $P < 0.0001$): Blue Bayou produced corms with a larger diameter (30.20 ± 0.24 mm) than Yvonne (26.57 ± 0.27 mm) (Table 2). Regarding the planting date factor, a highly significant effect was observed ($F = 221.51$; $df = 285$; $P < 0.0001$), with a reduction in diameter as planting was delayed. The highest value was obtained at the earliest date (35.35 ± 0.41 mm) and the lowest at the latest date (21.50 ± 0.38 mm) (Table 2). This trend is consistent with findings reported by Kocira *et al.* (2015) in *Acidanthera bicolor* (Iridaceae), and by Ahmad *et al.* (2011), Fatihullah and Bostan (2018), and Yayğin *et al.* (2022) in gladiolus under the environmental conditions of Pakistan and Turkey.

The number of cormels per corm did not show a significant interaction between planting date and variety ($F = 1.21$; $df = 285$; $P = 0.3065$), nor were significant differences observed between varieties ($F = 2.88$; $df = 285$; $P = 0.0906$), with average values of 3.34 ± 0.11 for Blue Bayou and 3.09 ± 0.10 for Yvonne (Table 2). However, planting date had a significant effect ($F = 66.37$; $df = 285$; $P < 0.0001$). The highest number of cormels was obtained at the earliest planting date (5.18 ± 0.17), and the lowest at the latest date (1.66 ± 0.15). This trend was also reported by Fatihullah and

Bostan (2018) and Yayğin *et al.* (2022). However, the results of the present study differ from those reported by Ahmad *et al.* (2011), who found that in gladiolus, delaying planting into the warmer months of the year positively influenced cormel number.

Table 1. Corm weight and average cormel weight of two *Freesia* × *hybrida* varieties at five planting dates.

Treatment	Corm weight ± SE (g)	Average cormel weight ± SE (g)
T1	19.43 ± 0.64 a	2.04 ± 0.14 a
T2	16.98 ± 0.83 b	2.02 ± 0.11 a
T3	16.66 ± 0.65 b	1.85 ± 0.12 a
T4	15.35 ± 0.74 b	2.10 ± 0.14 a
T5	12.58 ± 0.60 c	1.74 ± 0.11 a
T6	7.37 ± 0.66 d	1.18 ± 0.12 b
T7	8.21 ± 0.51 d	0.98 ± 0.09 b
T8	5.25 ± 0.63 e	0.60 ± 0.11 c
T9	5.35 ± 0.55 e	0.52 ± 0.10 c
T10	4.39 ± 0.61 e	0.34 ± 0.11 c

Mean values ± standard error (SE) are presented. Means followed by different letters within each column indicate significant differences according to the DGC test ($P < 0.05$). Treatments: T1: V1D1, T2: V2D1, T3: V1D2, T4: V2D2, T5: V1D3, T6: V2D3, T7: V1D4, T8: V2D4, T9: V1D5, and T10: V2D5.

Table 2. Effect of variety and planting date on equatorial diameter and number of cormels of two *Freesia* × *hybrida* varieties at five planting dates.

Variety	Equatorial diameter ± SE (mm)	Number of cormels ± SE
Blue Bayou	30.20 ± 0.24 a	3.34 ± 0.11 a
Yvonne	26.57 ± 0.27 b	3.09 ± 0.10 a
Date		
D1	35.35 ± 0.41 a	5.18 ± 0.17 a
D2	33.53 ± 0.46 b	3.74 ± 0.19 b
D3	27.77 ± 0.41 c	2.97 ± 0.17 c
D4	23.76 ± 0.37 d	2.52 ± 0.15 c
D5	21.50 ± 0.38 e	1.66 ± 0.15 d

Mean values ± standard error (SE) are presented. Means followed by different letters within each column indicate significant differences according to the DGC test ($P < 0.05$).

The results of this trial suggest that early planting dates promote corm growth and cormel production in *F.* × *hybrida*. Renau-Morata *et al.* (2012) noted that corm size depends on the supply of carbohydrates derived from photosynthesis. In the present study, the higher production of storage structures at earlier planting dates may be associated with a longer vegetative phase and a greater number of leaves, as previously documented by Santilli *et al.* (2023). Similar findings were observed in tulip (Khan *et al.*, 2008), *Acidanthera bicolor* (Kocira *et al.*, 2015), Crocosmia (Amişculesei *et al.*, 2022), and gladiolus (Javaid *et al.*, 2025). The production of heavier and larger storage structures positively impacts the subsequent crop cycle. Kumari *et al.* (2023) reported that larger corms, due to their higher reserve content, promote more vigorous growth and increased production of new corms.

Conclusions

Under the environmental conditions of Tucumán, Argentina, both genotype and planting date significantly influence the size and multiplication of corms and cormels in *F.* × *hybrida*. Early planting dates (February 15 and March 19) resulted in the highest corm weight and diameter, as well as a greater number and average weight of cormels in Blue Bayou and Yvonne.

The findings provide valuable information for optimizing propagation strategies in *F.* × *hybrida*, highlighting the importance of planting date selection for enhancing the efficiency of corm and cormel production.

References

Ahmad I., Khattak A.M., Ara N., Noor-Ul-Amin (2011). Effect of planting dates on the growth of gladiolus corms in Peshawar. Sarhad Journal of Agriculture 27 (2): 195-199.

Ahmed S., Sultana S., Kawochar M.A., Naznin S., Tuli F.U. (2015). Effect of corm size and nitrogen on the growth and flowering of gladiolus (*Gladiolus grandiflorus* L.). Emergent Life Sciences Research 1 (1): 18-25.

Amişculesei P., Apostol M., Bernardis R.R., Draghia L. (2022). Influence of the planting season and corms size on the Crocosmia, in agroclimatic conditions of Iasi (northeastern Romania). Scientific Papers. Series B. Horticulture 66 (1): 624-631.

Amjad N., Ahmad I., Qasim M. (2018). Optimizing planting time for some selected commercial gladiolus cultivars under agro-climatic conditions of Faisalabad, Pakistan. Journal of Horticultural Science and Technology 1 (1): 21-27.

Di Rienzo J.A., Casanoves F., Balzarini M.G., Gonzalez L., Tablada M., Robledo C.W. (2020). InfoStat, versión 2020. En: Grupo InfoStat, Facultad de Ciencias Agropecuarias, Universidad Nacional de Córdoba, Argentina.

Fatihullah, Bostan N. (2018). Effect of different planting dates on gladiolus production. International Journal of Environmental Sciences & Natural Resources 9 (1): 21-25. https://doi.org/10.19080/IJESNR.2018.08.555753

Faust J.E., Dole J.M. (2021). The global cut flower and foliage marketplace. En: Cut flowers and foliages. Faust J.E., Dole J.M. (Eds.). CABI, Estados Unidos. Pp. 1-47.

Ferdousi S., Ferdousi J., Islam M., Nath D., Hossain M. (2018). Effects of corm size and planting date on flower and corm production of gladiolus in Sylhet region. Asian Journal of Agricultural and Horticultural Research 1 (1): 1-9.

Fernández-Long M.E., Hurtado R.H., Spescha L. (2015). Planilla de cálculo de variables astronómicas (VARAST 1.0). Revista Agronomía & Ambiente 35 (2): 171-177.

Hossain T.M., Pitol M.N.S., Mannan M.A., Khan S.K.U. (2021). Impact of corm size and phosphorous on growth and floral characteristics of gladiolus (*Gladiolus grandiflorus*). Asian Journal of Agriculture 5 (2): 90-97.

Javaid A., Pandey R.K., Shah A.H., Bakshi P., Nazki I.T., Kaushal N., Chand G., Dogra S., Kumar R., Singh A.K., Singh A. (2025). Response of Gladiolus grandiflorus varieties to planting date: effects on growth, flowering, and vase life. BMC Plant Biology 25: 481. https://doi.org/10.1186/s12870-025-06472-3.

Khan F.U., Jhon A.Q., Khan F.A., Mir M.M. (2008). Effect of planting time on flowering and bulb production of tulip under conditions in Kashmir. Indian Journal of Horticulture 65 (1): 79-82.

Kocira A., Laskowska H., Kocira S. (2015). Yield of corms of *Acidanthera bicolor* var. *murielae* perry depending on the date and depth of planting corms. Acta Agrobotanica 68 (1): 89-96.

Kumari K., Padhi M., Sisodia A., Singh A.K., Barman K. (2023). Varietal performance on growth and corm yield attributes in gladiolus. Environment and Ecology 41 (1A): 308-312.

Mahmood S.G., Adil A.M., Al-Taae H.H. (2023). Effect of corm size, Aloe vera gel and biofertilizers on the growth of Freesia plant (*Freesia hybrida* L.). IOP Conference Series: Earth and Environmental Science 1259 (1).

Nafees M., Ahmad I., Qureshi R., Ashraf I., Maqsood A., Aslam M.N., Noor-Un-Nisa M. (2021). Cultivars and corm size response for gladiolus flower and corms production in arid region of Bahawalpur. Pakistan Journal of Botany 53 (2). https://doi.org/10.30848/PJB2021-2(1)

Pallotti C., Renau-Morata B., Cardone L., Nebauer S.G., Albiñana Palacios M., Rivas-Sendra A., Seguí-Simarro J.M., Molina R.V. (2024). Understanding the saffron corm development: insights into histological and metabolic aspects. Plants 13: 1125. https://doi.org/10.3390/plants13081125

Renau-Morata B., Nebauer S.G., Sánchez M., Molina R.V. (2012). Effect of corm size, water stress and cultivation conditions on photosynthesis and biomass partitioning during the vegetative growth of saffron (*Crocus sativus* L.). Industrial Crops and Products 39: 40-46.

Santilli M., Bas-Nahas S.S., Medrano N. (2021). Freesia crop (*Freesia* × *hybrida*) phenological growth stages according to the BBCH scale. Revista Agronómica del Noroeste Argentino 41 (1): 15-26.

Santilli M., Bas-Nahas S.S., Medrano N. (2023). Occurrence and duration of phenological phases of *Freesia* × *hybrida* grown at different planting dates. Ornamental Horticulture 29 (2): 200-207. https://doi.org/10.1590/2447-536X.v29i2.2568

Singh S.R.P., Singh A.P., Kumar V., Tiwari D., Pal M., Yadav P., Ojha M.D. (2024). Studies on effect of genotypes and planting time on growth and corm characters of gladiolus. Journal of Experimental Agriculture International 46 (10): 243-249.

Yayğin T., Erden K., Pakyürek A.Y. (2022). Effects of different planting times and corm sizes on plant growth, development, and flower production of gladiolus (*Gladiolus grandiflorus*) under Sanliurfa conditions. Journal of Applied Sciences 7 (1): 23-31. https://doi.org/10.52520/masjaps.197