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Rhyncattleanthe Aurora's José Françolin– a multiflora material and its genetic selection factors

Rhyncattleanthe Aurora's José Françolin– um híbrido multiflora

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Abstract: Brazilian flower production demands new materials, especially for orchids. Hybrid production could be a form of gene conservation as the pure species plants are subjected to several harms in the wild. This hybrid's origin was considered a multiflora plant derived from *Guarianthe bowringiana* descents. *Rhyncattleanthe* Aurora's José Françolin is a novelty hybrid derived from a cross between *Rhyncattleanthe* Aurora's Blue Pride #1, a plant with 25% *Guarianthe bowringiana* that gives the character multiflora with well-formed flowers, and *Rhyncolaeliocattleya* Turandot "Guaxupé" a known clone with exceptional features. *Rhyncattleanthe* Aurora's José Françolin bears spikes of up to five flowers in a medium to big sized, well-armed, with heavy substance ranging from light rose to dark lavender and broad petals, many of them with a broad labellum also, flowers are lightly scented and well adapted to warmer climates. The best clones were selected based on the genetic parameter of petal width (PW, $h^2 = 0.854$) instead of natural diameter (D, $h^2 = 0.935$) due to better flower shape and balance between the other floral segments. Some superior clones are being selected as stud plants and for cloning, for a superior floral count than RC Turandot and good-sized flowers (more than 10 mm in each dimension than RCT Aurora's Blue Pride #1). Genetic parameters such as the petal width is useful to select superior clones.
Keywords: *Cattleya* hybrid group, floriculture, orchid hybrid, plant breeding, pot plant.

Resumo: A produção brasileira de flores demanda novos materiais, especialmente para orquídeas. A produção híbrida pode ser uma forma de conservação genética, pois as plantas de espécies puras são submetidas a vários perigos na natureza. Este híbrido é considerado uma planta multiflora descendente de *Guarianthe bowringiana*. *Rhyncattleanthe* Aurora's José Françolin é um híbrido inovador derivado de um cruzamento entre *Rhyncattleanthe* Aurora's Blue Pride #1, uma planta com 25% de *Guarianthe bowringiana* que dá o caráter multiflora com flores bem formadas, e *Rhyncolaeliocattleya* Turandot "Guaxupé", um clone conhecido com características excepcionais. *Rhyncattleanthe* Aurora's José Françolin produz cachos de até cinco flores de tamanho médio a grande, bem armadas, com substância pesada variando de rosa claro a lavanda escuro e pétalas largas, muitas delas com um labelo largo também, as flores são levemente perfumadas e bem adaptadas a climas mais quentes. Os melhores clones foram selecionados com base no parâmetro genético da largura da pétala (PW, $h^2 = 0{,}854$) em vez do diâmetro natural (D, $h^2 = 0{,}935$) devido ao melhor formato da flor e equilíbrio entre os outros segmentos florais. Alguns clones superiores estão sendo selecionados como plantas reprodutoras e para clonagem, para uma contagem floral superior à RC Turandot e flores de bom tamanho (mais de 10 mm em cada dimensão do que a RCT Aurora's Blue Pride #1). Parâmetros genéticos como a largura da pétala são úteis para selecionar clones superiores.
Palavras-chave: híbrido de orquídea, floricultura, grupo híbrido de *Cattleya*, melhoramento de plantas, planta de vaso.

Introduction

Brazilian flower production demands new materials for tropical species, especially for orchids (Cardoso et al., 2016; Junqueira and Peetz, 2017; Silva et al., 2017; Machado Neto, 2019; Machado-Neto et al., 2022). The *Cattleya* breeding group (CBG) or *Cattleya* hybrid group (CHG) is a collection of neotropical species that could interbreed, creating hybrids that are among the most valuable flowers but with slow development for many species in comparison with *Phalaenopsis*, *Dendrobium* or *Oncidium* alliances (Stulzer et al., 2019; Suarez-Guerra and Tellez-Beltran, 2020; Yuan et al., 2021; Subrahmanyeswari et al., 2022; Wu et al., 2022; Balilashaki et al., 2023; Minamiguchi et al., 2023). One of the ways of doing that is to increase production of hybrid materials, which will be a form of plant conservation as the pure species plants are subjected to several harms in the wild (Reiter et al., 2020; Brown et al., 2024) and making hybrids with selected species, even if gone extinct in the wild, their genes will be preserved, and it will lower the pressure over the natural populations (Soltis & Gitzendanner, 1999; Allendorf et al., 2001). Illegal trade is also a menace to the world flora (Hinsley et al., 2018, 2016) as it increases the number collected from the wild.

Guarianthe bowringiana is a Centro-American species distributed from Southeast Mexico to Honduras (Govaerts, 2023). It is a fast grower that thrives well in bright environments and grows profusely, flowering in long spikes with up to 15 flowers (Withner, 1988). These characteristics are passed to its descendants, conferring a more compact growth and increasing the floral count. However, its hybrids, especially some with the *Cattleya* genus, exhibit a kind of sterility, especially when a tetraploid plant is crossed with a diploid one, generating a triploid progeny (Felix and Guerra, 2010; Silva et al., 2017) or due to fertility barriers (Arida et al., 2021). *Cattlianthe* (CT) Portia "Baronesa" is a very beautiful coerulea plant that makes producing some offspring difficult, but it is more fertile than the CT. Portia "Gloriosa". Some more complex clones, such as *Rhyncattleanthe* Congaree, have nice inflorescences with good-shaped flowers in pink and a nice reddish labellum, but they do not thrive well in our environments. It is a model for obtaining a plant that will grow well here.

A breeding program was established in 1999 by our nursery, mainly for *Cattleya* hybrids, focusing on transferring such characteristics from *Guarianthe bowringiana* and the rupiculous *Cattleya* to obtain compact plants and high-counting flowered plants.

Genetic origin and development

Rhyncattlianthe (RCT) Aurora's José Françolin is a hybrid registered in the Royal Horticultural Society under 33360 in December 2021. It is the progeny of the cross made using *Cattlianthe* (CT) Aurora's Blue Pride as a capsule-bearing genitor and *Rhyncholaeliocattleya* (RC) Turandot "alba" as a pollineas donor. The capsule developed for eight months and was collected when the first signs of maturation appeared. It was kept in a paper envelope and allowed to complete the maturation in a chamber over a layer of silica gel. It produced a large number of viable seeds.

Seeds were disinfested using 5 g L^{-1} of sodium dichloroisocyanurate with 100 µL Tween 80 as a wetting agent (Francisqueti et al., 2024) during

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10 minutes in this solution with some mixtures by inversion during this period. After that, seeds were washed twice in distilled autoclaved water and sowed in a ½ strength MS media (Murashige and Skoog, 1962) with 20 g L^{-1} sucrose and 8 g L^{-1} of agar; the pH of the media was adjusted to 5.6, and the media was autoclaved and distributed in Petri dishes (60 mm in diameter). Seedlings were transferred to flasks after 90 days and reflasked every 90 days until the seedlings reached at least 15 mm high. Seedlings were deflasked, washed carefully to remove agar debris, and immersed in a solution containing 2 g L^{-1} methyl tiophanate for at least one hour. The solution was drained, and the seedlings were allowed to dry and planted in community pots using chopped sphagnum moss as substrate. They received weekly fertilization using a hydro-soluble feeding with a 15:05:15 plus micronutrient formula at 0.47 g m^{-2}. If pests or diseases were found, the needed care was taken. After one year, the plants were transferred to individual pots (5cm) filled with 1/3 of gravel and a potting mix of fine granulometry *Pinus* bark (PB; < 5 mm) and chopped *Sphagnum* moss (SM; 1:1, v:v) and remained there for almost another year. When the plants were 15 cm in height, they were transferred to the bigger pots with 1/3 gravel and a medium granulometry PB (< 12 mm) until flowering (at least more than two years).

Material characteristics

Rhyncattleanthe Aurora's José Françolin plants are medium to large-sized plants (25-50 cm high), mostly unifoliate. The flowers (Fig. 1), from two to six, are medium to big-sized dark pink with dark rose mid lobe and yellow in the throat. The size of the flowers of the offspring and the parental plants is shown in Table 1. This hybrid grows nicely and fast in warmer environments and flowers in the late autumn and early winter.

Table 1. Flower measurements of RCT Aurora's José Françolin and its parents.

	Flower diameter (mm ± SE)	Petal width (mm ± SE)	Labellum mid-lobe width (mm ± SE)
Cattlianthe Aurora's Blue Pride	116.35 ± 10.70	42.41 ± 3.52	38.06 ± 3.94
RC Turandot	191.58 ± 3.83	99.47 ± 1.98	77.89 ± 0.88
RCT Aurora's José Françolin	126.14 ± 12.109	54.34 ± 7.47	46.91 ± 6.24

Selection characteristics

Although many criteria should be used for selection purposes, such as precociousness and colour (Cardoso, 2010; Cardoso et al., 2016), only a few studies (Machado Neto, 2019; Machado-Neto et al., 2022) published some characteristics that have a genetic background to be used. The one with CTT Aurora's Blue Pride, the parent of this presented hybrid, showed that petal width and Labellum mid lobe were good markers to be followed.

Flowers from 65 individuals from this hybrid and the parental plants were measured, as shown in Fig. 1, and the measurements are presented in Table 1.

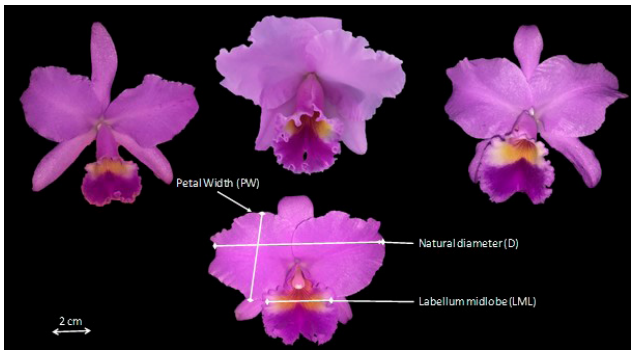

Fig. 1. Flowers of RCT Aurora's José Françolin seedlings in bloom, and the lines show where the measurements were taken.

Using Formula 1, we can calculate the genetic gain by selecting and deciding which flower characteristic would be preferable.

$$\textbf{Formula 1} - GS = h^2.DS;$$

GS is the gain with selection, h^2 is the character's heritability, and DS is the differential with selection, calculated as the difference between the average of the original population and the selected individuals.

The formula 2 calculated heritability.

$$\textbf{Formula 2} - h^2 = \frac{\sigma^2 F - \sigma^2 E}{\sigma^2 F};$$

where σ^2F is the variance of the hybrid population, and σ^2E is the environmental variability measured as the average of the two parental plants.

The percentual genetic gain was calculated by the formula 3.

$$\textbf{Formula 3} - GS\% = (GS/\overline{Xo}) \times 100,$$

where GS is the gain with selection and is the average of the initial population.

The average of the superior population ($\overline{x}_S$) was calculated using the formula 4:

$$\textbf{Formula 4} - \overline{X}s = \overline{X}o + GS$$

These values were calculated for the flower's natural diameter (D), petal width (PW), and Labellum mid-lobe width (LML), as shown in Table 2. Dorsal sepal (Dsp) was measured but was not used as selection criteria.

The use of diameter (h^2 = 0.935) as a selection factor was positively related to other variables with GS% of 13.79, 12.40, and 11.90, respectively, for PW, Dsp, and LML. The PW character with an h^2 of 0.854 is positively related to D, Dsp and LML with GS% of 10.19, 16.72, and 11.90, respectively. The LML (h^2 = 0.678) with is also positively related to D, PW, and Dsp, with 5.46, 8.65, and 6.45 GS%, respectively.

Considering the heritability of each character, it should be expected that diameter could be used as a major factor for selection; however, it was observed that in the case of this cross, the PW was more effective in selecting a good flower than its overall diameter. The LML has lower heritability and could even be used as a selection factor, but it did not present the best genetic gains. The percentage difference for D between the %GS using D or PW was small (2.25 mm or 3.02%), but the flower seems to be more equilibrated when using the PW as a primary selection character followed by the D. The PW also presented the highest increase in the Dsp, enlarging the dorsal sepal and giving the flower a better shape and balance between all pieces.

In plants that do not have *Cattleya* for the section Cyrtolaelia as described by Machado-Neto et al. (2022), where both PW and LML have a positive impact on the flower composition, petal width (PW) is a better choice for the *Catteya* Hybrid Group with large flowers with *Guarianthe* in their genealogy.

Growing Conditions

The plants are currently maintained in black plastic pots filled with broken macadamia nut shells in a shade house (50% of shadow), fertigated once a week with a 15-05-15 NPK (0.47 g m^{-2}) plus secondary macro and micronutrient. The commonly used phytosanitary practices for orchid cultivation were applied.

Table 2. Genetic parameters for selection of RCT Aurora's José Françolin and its impact on differential with selection (DS), gain with selection (GS), percent gain with selection (GS%) and mean of the improved population ($\overline{x}_S$) on flower components as Diameter (D), Dorsal sepal (Dsp), Petal Width (PW) and Labellum mid-lobe width (LML).

Selection criteria	Heritability (h^2)		DS*	GS**	GS%§	§§
Diameter (mm)	0.935	D	17.10	16.07	13.62	143.33
		PW	7.49	6.40	13.79	61.83
		Dsp	2.87	2.58	12.40	26.00
		LML	5.58	3.78	11.90	52.50
Petal width (mm)	0.854	D	12.85	12.02	10.19	139.00
		PW	11.33	9.70	20.85	65.67
		Dsp	3.87	3.48	16.72	27.00
		LML	5.58	3.78	11.90	52.50
Labellum mid lobe width (mm)	0.678	D	6.89	6.44	5.46	133.04
		PW	4.70	4.01	8.65	59.04
		Dsp	1.49	1.34	6.455	24.62
		LML	9.65	6.54	20.56	56.56

* Differential with selection, ** Gain with selection, §Percent Gain with selection and §§Mean of improved population

Performance (productivity data and comparison with commercial cultivars)

The plants are vigorous growers, bearing up to five flowers per stem.

Uses, Availability

RCT Aurora's José Françolin grows well either as pot plants or in living supports, developing nice clumps full of flowers in the autumn/winter. The plants are maintained in the private Orquidário Aurora, located close to the state highway SP483, in Taciba, São Paulo. Some plants are being selected based on the criteria established here and separated to enter as parents in our breeding program and to be cloned in the next years.

Originality

This article is original, prepared and submitted just to this Journal.

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Author contribution

NBMN: Conceptualisation, design of methodology and data analysis, prepared the draft of the manuscript, revised the manuscript and approved the final version. **CCC:** Conceptualisation, design of methodology and data analysis, prepared the draft of the manuscript, revised the manuscript and approved the final version. **TBSU:** Data acquisition, design of methodology and data analysis, prepared the draft of the manuscript, revised the manuscript and approved the final version.

Conflict of interest

The authors declare no conflict of interest. The founding sponsors had no role in the study's design, the collection analysis or interpretation of data, the writing of the manuscript, or the decision to publish the results.

Data Availability Statement

The research data is contained in the manuscript.

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