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ARTICLE

Pepper genotypes of the genus *Capsicum* sp. for ornamental uses

Genótipos de pimentas do gênero *Capsicum* sp. para uso ornamental

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Abstract
The dynamics of the ornamental plant market have been transforming due to changes in consumer preferences and demands. In this context, the aesthetic value of species has been associated with additional functions, highlighting the concept of multiple uses, which integrates both food and ornamental purposes. Peppers (*Capsicum* spp.) stand out for presenting desirable characteristics such as compact growth habit, edible use, and adaptability to cultivation in pots under both indoor and outdoor conditions. However, the low standardization of genotypes and the limited availability of commercial varieties still represent constraints to the expansion of this segment. In this regard, the objective of this study was to characterize the morphology and ornamental potential of different pepper genotypes of the genus *Capsicum* spp. The experiment was conducted in a completely randomized design, with twelve replications per genotype, totaling 360 experimental units. Morphological and ornamental traits were evaluated using international morphological descriptors for *Capsicum*, associated with classification criteria for ornamental plants established by the national market. The genotypes USP CA 010, USP CA 023, USP CA 028, and USP CA 044 stood out for presenting a greater number of ornamental characteristics, including compact architecture, and fruit production with intense coloration contrasting with the foliage. The morphological and ornamental characterization highlighted the variability among genotypes and proved to be effective in identifying promising materials for breeding programs and for the ornamental plant market.
Keywords: Genetic diversity, ornamental descriptors, plant breeding, potted plants.

Resumo
A dinâmica do mercado de plantas ornamentais tem se transformado em função das mudanças nas preferências e exigências dos consumidores. Nesse contexto, o valor estético das espécies tem sido associado a outras funções, evidenciando o conceito de múltiplos usos, que integra finalidades alimentares e ornamentais. As pimentas *Capsicum* spp. destacam-se por apresentarem características desejáveis, como porte reduzido, uso comestível e adaptabilidade ao cultivo em vaso sob ambientes internos e externos. Entretanto, a baixa padronização dos genótipos e a limitada disponibilidade de variedades comerciais ainda representam entraves para a expansão desse segmento. Diante disso, objetivou-se caracterizar a morfologia e o potencial ornamental de diferentes genótipos de pimentas do gênero *Capsicum* spp. O experimento foi conduzido em delineamento inteiramente casualizado, com doze repetições por genótipo, totalizando 360 unidades experimentais. Foram avaliados atributos morfológicos e ornamentais por meio de descritores morfológicos internacionais para *Capsicum*, associados a critérios de classificação de plantas ornamentais estabelecidos pelo mercado nacional. Os genótipos USP CA 010, USP CA 023, USP CA 028 e USP CA 044 destacaram-se por apresentarem maior número de características ornamentais, incluindo arquitetura compacta, e produção de frutos com coloração intensa e contrastante com a folhagem. A caracterização morfológica e ornamental evidenciou a variabilidade entre os genótipos e mostrou-se eficiente na identificação de materiais promissores para programas de melhoramento e para o mercado de plantas ornamentais.
Palavras-chave: Descritores ornamentais, diversidade genética, melhoramento genético, plantas envasadas.

Introduction

The production of ornamental plants has become prominent within the agribusiness market of floriculture. In 2023, the production chain showed an 8% growth, reaching a Gross Domestic Product (GDP) of 19.9 billion reais (Ibraflor, 2024). Given the increasing demand and market trends in floriculture, as well as consumer requirements, there is a clear need to expand the level of innovation in the sector, particularly through the development of new ornamental plant varieties (Tamura et al., 2024).

According to Rheinheimer et al. (2024), the ornamental plant market has increased investments aimed at producing species of ornamental interest cultivated in pots. In this context, in addition to species traditionally used in floriculture, plants with multiple uses those that hold both food and ornamental value have recently been introduced. Among these potted plants, ornamental sweet potatoes, peppers, and tomatoes stand out, as they simultaneously meet the demands of both the food and ornamental markets (Tamura et al., 2024; Ferreira et al., 2025; Campos et al., 2023).

Within this context, ornamental peppers are noteworthy. They belong to the botanical family Solanaceae and the genus *Capsicum*, which includes several cultivated species, among which the following stand out: *Capsicum annuum*, *C. chinense*, *C. baccatum*, and *C. frutescens* (Oliveira et al., 2023; Costa et al., 2019).

These species exhibit characteristics that go beyond ornamental value, including their functionality as food. However, many genetic materials still display undesirable traits for ornamental use, making it necessary to develop breeding programs aimed at obtaining new varieties and cultivars with greater decorative value (Custódio et al., 2023; Ferreira et al., 2025). In this process, priority is given to plants with a compact growth habit, high fruit production preferably with upright fruits well distributed throughout the canopy as well as the ability of the main stem to support itself (Costa et al., 2019; Guimarães et al., 2021).

Due to the wide genetic variability and the scarcity of studies focused on the breeding and adaptation of *Capsicum* peppers for large-scale cultivation systems, there are still challenges in standardizing materials intended for commercial production as ornamental plants (Ferreira et al., 2025). In this context, the characterization of morphological attributes of vegetative and reproductive structures is an important tool for differentiating genotypes and assessing the genetic proximity among plant materials. Additionally, the evaluation of progenies across multiple cultivation cycles enables the assessment of their similarity to the parental genotypes. (Lima et al., 2023).

According to Neitzke et al. (2016), the development of morphological characterization studies is essential for describing the ornamental potential of pepper species through quantitative and qualitative parameters. Furthermore, identifying favorable traits for obtaining improved materials for ornamental purposes can expand the range of plants available to the floriculture and ornamental plant markets (Costa et al., 2019; Zhong et al., 2021).

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In this context, the International Plant Genetic Resources Institute (IPGRI, 1995) establishes qualitative morphological descriptors that allow the evaluation of variability in *Capsicum* peppers. Among these descriptors are characteristics related to leaf color, shape, and pubescence, as well as fruit colors and shapes attributes that contribute to genotype differentiation and to the assessment of ornamental potential, including pot coverage capacity.

Moreover, Costa et al. (2019) and Ferreira et al. (2024) highlight that the specific characteristics of each genotype allow plants to be directed toward different purposes, such as pot cultivation, landscaping use, or industrial applications.

Therefore, the hypothesis of this study is that *Capsicum* spp. genotypes exhibit morphological variability and ornamental potential, making them suitable for use in breeding programs aimed at developing cultivars for the ornamental plant market. It is further hypothesized that the qualitative traits observed in these genotypes confer ornamental attractiveness consistent with market demands. Thus, the present study aimed to characterize the morphology of different *Capsicum* genotypes and identify those that exhibit the greatest number of desirable traits for the ornamental plant market.

Materials and Methods

Seeds from *Capsicum* spp. genotypes originating from the Active Germplasm Bank of the Vegetable Crop Breeding Laboratory at ESALQ/USP, in Piracicaba, SP, Brazil, were used.

Thirty pepper genotypes from four different species were selected: *Capsicum annuum*, *C. baccatum*, *C. chinense*, and *C. frutescens* (Table 1).

Table 1. Pepper genotypes of the genus *Capsicum* used for characterization, from the Active Germplasm Bank of the Vegetable Crop Breeding Laboratory at the "Luiz de Queiroz" College of Agriculture, University of São Paulo (ESALQ-USP).

Genotypes	Species	Common name
USP CA 007	*Capsicum annuum*	Kori Sikatame
USP CA 008	*Capsicum annuum*	Sinahuisa
USP CA 010	*Capsicum annuum*	Jamaica Yellow
USP CA 013	*Capsicum annuum*	Red elongated ornamental fruit
USP CA 014	*Capsicum annuum*	Jalapeño M
USP CA 019	*Capsicum annuum*	Rounded red Jalapeño
USP CA 023	*Capsicum annuum*	Ornamental rounded red fruit
USP CA 026	*Capsicum annuum*	Red oval jalapeño
USP CA 028	*Capsicum annuum*	Orange jalapeño
USP CA 029	*Capsicum annuum*	Red Jalapeño
USP CA 031	*Capsicum annuum*	Elvas Serrano
USP CA 033	*Capsicum annuum*	El Saltenito
USP CA 042	*Capsicum annuum*	Cabe Mera Besar
USP CA 043	*Capsicum annuum*	Red conical jalapeño
USP CA 044	*Capsicum annuum*	Ornamental plant with large red fruit
USP CA 045	*Capsicum annuum*	Red elongated jalapeño
USP CC 003	*Capsicum chinense*	Yellow Murupi
USP CC 005	*Capsicum chinense*	Red biquinho pepper
USP CC 018	*Capsicum chinense*	Kharika
USP CC 019	*Capsicum chinense*	Red Savina
USP CC 020	*Capsicum chinense*	Red olho-de-peixe pepper
USP CC 021	*Capsicum chinense*	Habanero Orange
USP CC 025	*Capsicum chinense*	Cumari-do-Pará pepper
USP CC 032	*Capsicum chinense*	Lemon pepper
USP CC 035	*Capsicum chinense*	Elongated red Ituiutaba pepper
USP CC 037	*Capsicum chinense*	Salmon habanero
USP CB 003	*Capsicum baccatum*	Yellow dedo-de-moça pepper
USP CB 004	*Capsicum baccatum*	Red triangular dedo-de-moça pepper
USP CB 005	*Capsicum baccatum*	Red rounded dedo-de-moça pepper
USP CF 001	*Capsicum frutescens*	Tabasco

Location of the Experiment

The experiment was conducted from May to September in a greenhouse designated for fruit vegetable cultivation at the Department of Genetics of the "Luiz de Queiroz" College of Agriculture, University of São Paulo, located in the municipality of Piracicaba (altitude 546 m, latitude 22°42'31.2" South, and longitude 47°38'05.8" West). The region has a humid subtropical zone oceanic climate, without dry season with hot summer (Cfa), according to the Köppen classification (Alvares et al., 2013).

Plant Propagation

The seeds were germinated in plastic seedling trays filled with commercial substrate for vegetable seedlings (Carolina Soil®). Eighteen viable seeds per genotype were used, each sown individually in the tray cells.

After emergence, twelve seedlings of each genotype were selected. At 45 days after germination, when they had between four and six pairs of leaves, the seedlings were transplanted into 3-L pots filled with commercial substrate for vegetable cultivation (Base®).

Establishment of the Experiment

The plants were kept in the greenhouse after being transplanted into their final pots, with a spacing of 0.5 m between pots and 1.0 m between rows. The experiment was conducted in a completely randomized design (CRD), with 12 replicates for each pepper genotype. However, since the primary objective of the study was the morphological characterization and description of the ornamental potential of the evaluated materials, the assessments were qualitative, focusing on morphological and aesthetic traits of ornamental interest. Therefore, no statistical analyses were performed on quantitative and qualitative data, as the purpose of the study was to describe and compare the observed characteristics of the genotypes using morphological descriptors, with the aim of identifying materials with potential for ornamental use.

The qualitative data obtained for the remaining genotypes are not presented in this article because they did not exhibit the key morphological characteristics considered essential for the selection of plants with a greater number of ornamental attributes. Therefore, these genotypes were not regarded as promising for ornamental purposes and were excluded from the detailed morphological description, allowing the discussion to focus on the materials with the highest ornamental potential.

Irrigation was carried out using an automated micro-sprinkler system in the morning and afternoon. Fertilization was performed via fertigation three times per week, using a nutrient solution diluted in 500 L of water, according to Miranda et al. (2011).

Fertigation applications were carried out on three days of the week, following the sequence below:

Monday: 435 g of calcium nitrate, 102 g of monopotassium phosphate (MKP), 150 g of potassium nitrate, 87 g of potassium sulfate, 163 g of magnesium sulfate, 25 g of chelated iron (6% Fe), and 15 g of Rexolin.

Wednesday: 220 g of calcium nitrate, 50 g of monopotassium phosphate (MKP), 75 g of potassium nitrate, 45 g of potassium sulfate, 85 g of magnesium sulfate, 10 g of chelated iron (6% Fe), and 8 g of Rexolin.

Friday: 220 g of calcium nitrate, 50 g of monopotassium phosphate (MKP), 75 g of potassium nitrate, 45 g of potassium sulfate, 85 g of magnesium sulfate, 10 g of chelated iron (6% Fe), and 8 g of Rexolin.

The potted plants grown in the greenhouse were exposed to average minimum and maximum temperatures of 12 °C and 38 °C, respectively, and an average relative air humidity of 57.8%, during the period from May to September 2024.

Characterization of the genotypes

The 30 *Capsicum* pepper genotypes were characterized at the stage in which 50% of the fruits had reached maturity, using morphological descriptors specific to the genus, as proposed by the International Plant Genetic Resources Institute (IPGRI, 1995), an international reference for the morphological description of this botanical group (Table 2).

In addition to the morphological descriptors recommended by the International Plant Genetic Resources Institute (IPGRI, 1995), commercial criteria established by Cooperativa Veiling Holambra (2018) were also applied. These criteria define quality standards for classifying *Capsicum* genotypes with ornamental potential for pot cultivation (Table 3).

Table 2. Morphological descriptors for the characterization and evaluation of *Capsicum* spp. pepper genotypes. Adapted from IPGRI (1995).

DESCRIPTORS		
1. Stalk color	**10. Leaf margin**	**18. Filament color**
Green	Entire	White
Green with purple Stripes	Wavy	Greenish yellow
Purple	Ciliate	Blue
Other	**11. Leaf pubescence**	Light purple
2. Node anthocyanin	Sparse	Purple
Green	Intermediate	Other
Light purple	Dense	**19. Calyx annular constriction**
Purple	**12. Stem self-support**	Absent
Dark purple	Weak	Present
3. Stalk shape	Intermediate	**20. Anthocyanin spots on fruit**
Cylindrical	Strong	Absent
Angular	**13. Staking**	Present
Flattened	Yes	**21. Immature fruit color**
4. Stalk pubescence	No	Green
Sparse	**14. Flower position**	Light green
Intermediate	Erect	Dark green
Dense	Intermediate	Yellowish green
5. Growth habit	Pendant	Yellow
Prostrate	**15. Corolla color**	Purple
Compact	White	White
Erect	Light yellow	Black
Other	Yellow	Other
6. Branching density	Greenish yellow	
Sparse	Purple with white base	
Intermediate	White with purple base	
Dense	White with purple margin	
	Purple	
	Other	

Continue...

Table 2. Continuation.

DESCRIPTORS		
7. Leaf density	**16. Corolla spot color**	**22. Mature fruit color**
Sparse	White	White
Intermediate	Yellow	Lemon yellow
Dense	Greenish yellow	Pale orange-yellow
8. Leaf color	Green	Orange-yellow
Yellow	Purple	Orange
Light green	**17. Anther color**	Light red
Green	White	Red
Dark green	Yellow	Dark red
Light purple	Pale blue	Purple
Purple	Blue	Brown
Spotted / variegated	Purple	Black
Other	Other	Other
9. Leaf shape		**23. Fruit shape**
Deltoid		Elongated
Oval		Rounded
Lanceolate		Triangular
		Campanulate
		Blocky / rectangular
		Other

Table 3. Commercial classification criteria of Cooperativa Veiling Holambra for ornamental peppers grown in pots. Adapted from Ibraflor (2024).

High-Quality Criteria Veiling Holambra – Ibraflor	
Parameters	**Requirements**
Number of fruits	$\geq$ 10 *
Leaf density	Dense
Self-support / firm stem	Medium – high
Pot coverage	Good
Plant height	16 – 44 cm

Results and Discussion

Morphological diversity of the plants

The characterization of the pepper genotypes using morphological descriptors revealed clear differences among the evaluated materials. Variations were observed in plant size, growth habit, canopy architecture, leaf coloration, and floral and fruit attributes.

This diversity reflects the high morphological variability of the *Capsicum* genus, enabling the differentiation of genotypes based on traits that confer ornamental potential for pot cultivation.

Studies conducted by Ferreira et al. (2024) highlighted that ornamental pepper genotypes are primarily distinguished by contrasting characteristics related to the shape, position, and coloration of floral and fruit traits, as well as by the presence of anthocyanins in leaves and stems.

Cavalcanti et al. (2024) also emphasized that traits such as pungency, plant size, high leaf density, and high fruit production can add value and increase consumer interest in these ornamental plants.

Capsicum annuum L. species

The plants exhibited wide intraspecific variability, as evidenced by the morphological parameters evaluated. The genotypes belonging to this species, identified with the code “USP-CA,” stood out for presenting a greater number of ornamental characteristics.

In this study, the genotypes USP CA 010, USP CA 023, USP CA 028, and USP CA 044 were identified as promising materials for breeding programs focused on ornamental purposes. These plants displayed a compact growth habit, with heights below 44 cm, in accordance with the standards established by the national market. In addition, they showed high leaf density and foliage coloration that contrasted with the fruits, which varied in shape and color, with emphasis on yellowish, orange, and reddish tones (Table 4).

The genotype USP CA 010 exhibited a shrubby growth habit, with a height below 44 cm, an essential characteristic for pot cultivation and an important attribute influencing consumer purchasing preference (Cavalcanti et al., 2024). The plant showed a compact growth habit, with a cylindrical green stem, without the presence of anthocyanins in the internodes, as well as pubescence on both the stem and leaves, and an intermediate density of leaves and branches (Fig. 1).

Studies conducted by Neitzke et al. (2016) show that reduced plant size, combined with balanced plant architecture, is one of the main selection criteria in ornamental breeding programs. In addition, the absence of anthocyanins in the internodes, although it reduces vegetative visual contrast, may be compensated for by other ornamental traits, such as vibrant fruit coloration.

Table 4. Morphological characterization of the pepper genotypes USP CA 010, USP CA 023, USP CA 028, and USP CA 044 from the germplasm bank of the Vegetable Crop Breeding Laboratory at the 'Luiz de Queiroz' College of Agriculture, University of São Paulo (ESALQ-USP).

Descriptors	Genotypes			
	USP CA 010	**USP CA 023**	**USP CA 028**	**USP CA 044**
1. Stem color	Green	Green	Green	Green
2. Node anthocyanin	Green	Dark purple	Green	Green
3. Stem shape	Cylindrical	Cylindrical	Cylindrical	Cylindrical
4. Stem pubescence	Intermediate	Sparse	Sparse	Sparse
5. Growth habit	Compact	Compact	Compact	Compact
6. Branching density	Sparse	Dense	Intermediate	Dense
7. Leaf density	Intermediate	Dense	Dense	Dense
8. Leaf color	Green	Green	Green	Light green
9. Leaf shape	Lanceolate	Lanceolate	Lanceolate	Lanceolate
10. Leaf margin	Entire	Entire	Entire	Entire
11. Leaf pubescence	Sparse	Sparse	Sparse	Sparse
12. Stem self-support	Strong	Strong	Strong	Strong
13. Staking	No	No	No	No
14. Flower position	Intermediate	Erect	Pendant	Intermediate
15. Corolla color	White	White	White	White
16. Corolla spot color	Absent	Absent	Absent	Absent
17. Anther color	Pale blue	Purple	Blue	Pale Blue
18. Filament color	White	White	White	White
19. Calyx annular constriction	Absent	Absent	Absent	Absent
20. Anthocyanin spots on fruit	Absent	Absent	Absent	Absent
21. Immature fruit color	Light green	Green	Green	Light green
22. Mature fruit color	Yellow-orange	Red	Orange	Red
23. Fruit shape	Blocky campanulate	Triangular	Elongated	Triangular
24. Plant height	< 44 cm	< 44 cm	< 44 cm	< 44 cm

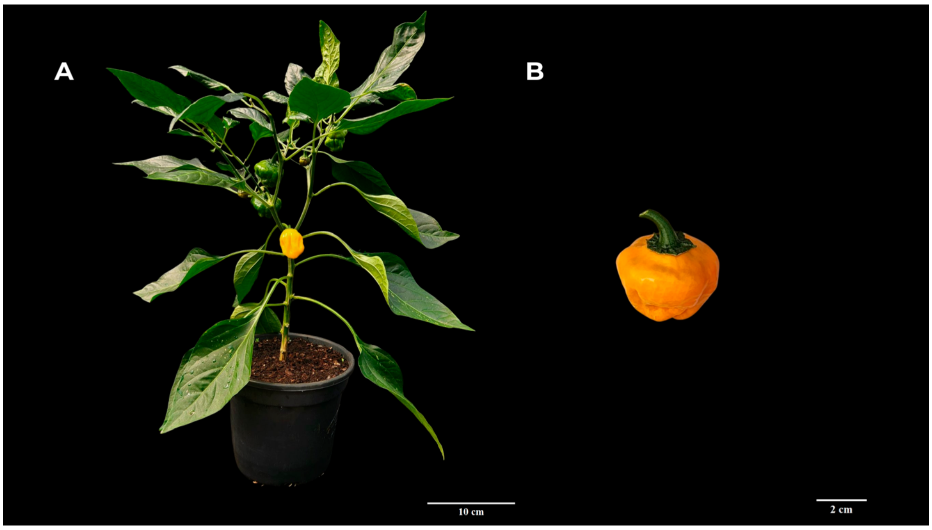

Fig. 1. Morphological aspects of the USP CA 010 genotype. (A) Potted plant showing plant size and architecture. (B) Fruit at physiological maturity.

The presence of pubescence and intermediate leaf density, besides contributing to the plant's visual attributes, is associated with evolutionary adaptations related to tolerance to abiotic stresses (Gasparini et al., 2021). Moreover, intermediate leaf densities may help modulate the microclimate, promoting better pot coverage, reducing temperature, and maintaining moisture near the base of the plant, as well as ensuring adequate light interception and ventilation. In this context, water balance is also favored, as the reduction in transpiration rate decreases water loss to the environment (Moreno-Teruel et al., 2026).

The leaves were classified as simple and lanceolate, with an acute apex and rounded base, and displayed green coloration. The flowers exhibited an intermediate position, with white petals, white filaments, and pale-blue anthers. The main stem showed high self-supporting capacity, eliminating the need for staking.

According to Costa et al. (2019), leaf shape and coloration play a secondary role in the ornamental attributes of peppers; however, they complement the plant's overall aesthetic composition, especially when associated with leaf density and fruit contrast. Uniform green coloration, combined with the stem's self-supporting capacity, represents an important agronomic advantage, as it eliminates the need for staking and reduces production costs in commercial systems.

Additionally, the strength of the main stem is directly associated with the ornamental quality of the plants, contributing to greater tolerance during transport and increased durability at the point of sale.

The fruits of this genotype ranged from medium to large in size and exhibited a blocky bell shape. In the immature stage, they displayed a light-green coloration, while at maturity they developed a yellow-orange color. At the end of the characterization, three to five flowers per plant were observed, with a production of four to six fruits per plant.

According to Ferreira et al. (2024), fruits constitute the main ornamental attribute in peppers. The genotype USP CA 010 presented high commercial attractiveness due to the change in coloration during ripening, with the transition from light green to yellow-orange being responsible for enhancing the aesthetic value of the plant.

In addition, although produced in smaller quantities, the fruits are relatively large and visually attractive, and their persistence on the plant contributes to greater acceptance in the ornamental market.

The genotype USP CA 023 exhibited a shrubby growth habit, with a height below 44 cm, compact growth, and high leaf and branch density traits desirable for ornamental use in pots. The cylindrical stem displayed green coloration with the presence of anthocyanins in the internodes (dark-purple tones) and absence of pubescence, resulting in predominantly glabrous plants (Fig. 2).

Fig. 2. Morphological aspects of the USP CA 023 genotype. (A) Potted plant showing plant size and architecture. (B) Fruit at physiological maturity.

Ferreira et al. (2024) highlighted the importance of intraspecific crosses for maintaining traits such as plant size and leaf density, favoring the development of individuals with superior attributes.

The genotype USP CA 023 presented simple, lanceolate leaves with an acute apex and rounded base, green coloration, and high leaf density. In addition, the plant exhibited strong self-supporting capacity, eliminating the need for staking. This morphological combination is typical of compact *Capsicum* pepper genotypes with ornamental potential.

The flowers were erect, with a white corolla, white filaments, and purple anthers, a pattern frequently observed in the genus, in which anther coloration may vary and contribute to genotype differentiation. The fruits were small, with a triangular to rounded shape, displaying green coloration in the immature stage and red coloration at maturity. This color transition is an important ornamental attribute, as it enhances visual appeal and increases the commercial value of pepper varieties (Cavalcanti et al., 2024; Rheinheimer et al., 2024).

These attributes reinforce the ornamental potential of the USP-CA 023 genotype, especially in pot cultivation systems, meeting the aesthetic standards required by the market (Ferreira et al., 2025; Silva et al., 2026).

The genotype USP CA 028 exhibited a shrubby growth habit, with a height below 44 cm, in accordance with the standards established by the national ornamental pepper market. The plant showed a compact growth habit, with a cylindrical green stem and the presence of anthocyanins at the leaf insertion points, expressed in dark-purple tones (Fig. 3).

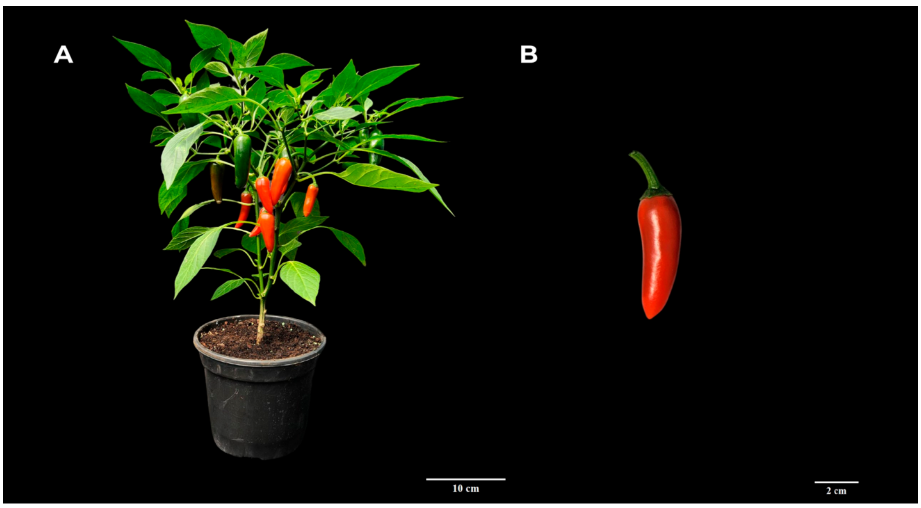

Fig. 3. Morphological aspects of the USP CA 028 genotype. (A) Potted plant showing plant size and architecture. (B) Fruit at physiological maturity.

In addition, the genotype did not exhibit pubescence on the stem or leaves, being predominantly glabrous. However, it showed high leaf density and an intermediate level of branching. These characteristics are considered relevant for ornamental pepper varieties and have been observed both in older cultivars and in those currently commercialized (Corley and Dempsey, 1971; Silva et al., 2026).

The leaves of the USP CA 028 genotype were classified as simple and lanceolate, with green coloration. The main stem exhibited strong self-supporting capacity, eliminating the need for staking. The flowers were pendant, with a white corolla, white filaments, and blue anthers. In this context, it is noteworthy that *Capsicum annuum* is generally characterized by its white corolla coloration, which is considered a diagnostic descriptor for identifying and distinguishing it from other species within the *Capsicum* genus (Costa et al., 2019; Ferreira et al., 2025).

The fruits showed medium to large size and an elongated shape, with green coloration at the immature stage and orange at maturity. High fruit set associated with the simultaneous presence of flowers was observed, indicating continuous flowering, a highly valued trait in the ornamental pepper market (Rêgo et al., 2022; Peterle et al., 2026).

The genotype USP CA 028 fits within the jalapeño pepper group, one of the most widely consumed pepper varieties worldwide. It produces large, elongated fruits with a thick mesocarp and low pungency due to the reduced concentration of capsaicin, being highly productive and widely used in gastronomy (Ulhoa et al., 2014; Viáfara-Vega et al., 2025; Júnior et al., 2025).

The genotype USP-CA 044 exhibited a shrubby growth habit, with a height below 44 cm and a compact growth pattern. The main stem was cylindrical, green in color, with no anthocyanin presence in the internodes or at the leaf insertion, and without pubescence, characterizing the plants as glabrous. The genotype showed high leaf density and branching (Fig. 4).

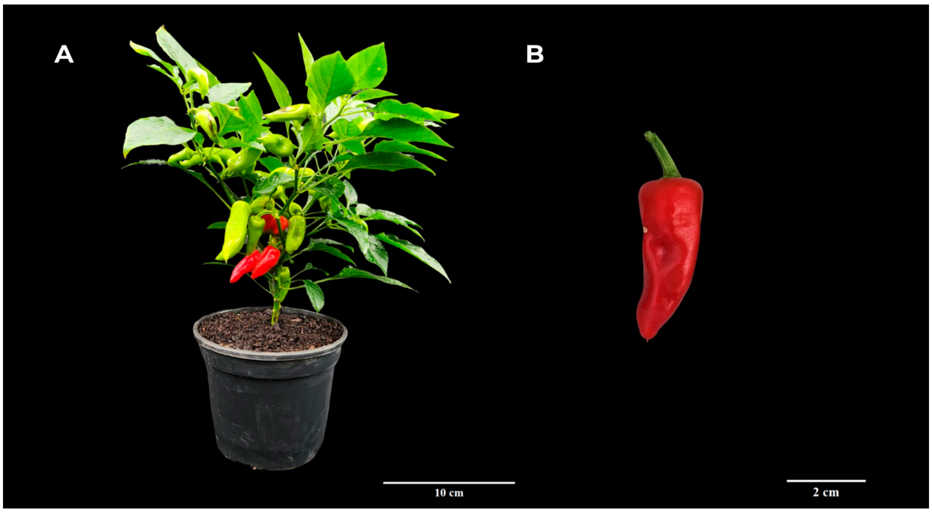

Fig. 4. Morphological aspects of the USP CA 044 genotype. (A) Potted plant showing plant size and architecture. (B) Fruit at physiological maturity.

The leaves of this genotype were classified as simple, lanceolate in shape, with an acute apex and rounded base, displaying a light-green coloration. The plant showed a high capacity for self-support of the main stem, eliminating the need for staking. In this context, these attributes are desirable in ornamental pepper breeding programs, especially when associated with contrasts between vegetative and reproductive structures, increasing the likelihood of consumer acceptance (Ferreira et al., 2025; Silva et al., 2026).

The genotype USP CA 044 exhibited intermediate flower positioning, with a white corolla and filaments, while the anthers stood out with a light blue coloration. As with the flowers, the fruits were numerous, large, and triangular in shape, showing a light green color at the immature stage and red at maturity. Only two color stages were observed during ripening, a characteristic common to most genotypes. However, the presence of three distinct color stages during fruit maturation in Capsicum spp. peppers can be considered an interesting secondary attribute to attract consumer interest, as these variations enhance contrasts among fruits, consequently increasing ornamental value (Rêgo et al., 2022; Cavalcanti et al., 2024).

The characteristics observed in the four genotypes highlighted in this study made it possible to differentiate these materials from the others, as they combined the greatest number of desirable morphological attributes that confer ornamental potential to the plants. These materials can be considered promising for use in breeding programs, aiming at composing sets of parents for future intervarietal crosses. Studies conducted by Melo et al. (2014) and Ribeiro et al. (2024) also observed that the selection of promising materials has enabled the development of diverse genotypes with high aesthetic value for the ornamental plant market.

In this context, the 26 genotypes mentioned in Table 1 also showed morphological diversity in vegetative and reproductive structures, evidenced by differences in plant architecture and in the shape and position of the fruits (Fig. 5A and 5B). However, because they exhibited a smaller number of ornamental attributes when compared to the four selected genotypes, the qualitative data for these materials will not be detailed in this article. For this reason, the discussion was directed toward the accessions that presented greater ornamental potential and best met the objectives proposed in this study.

Thus, the qualitative characterization of the remaining genotypes was not explored in depth, as their inclusion would result in extensive and repetitive descriptions with limited contribution to the interpretation of the results. The visual representation through plates complements the evaluation, highlighting the morphological variability observed among the genotypes (Fig. 5A and 5B).

Fig. 5A. Morphological aspects of *Capsicum* spp. genotypes cultivated in pots, belonging to the Active Germplasm Bank of the Luiz de Queiroz College of Agriculture, University of São Paulo.

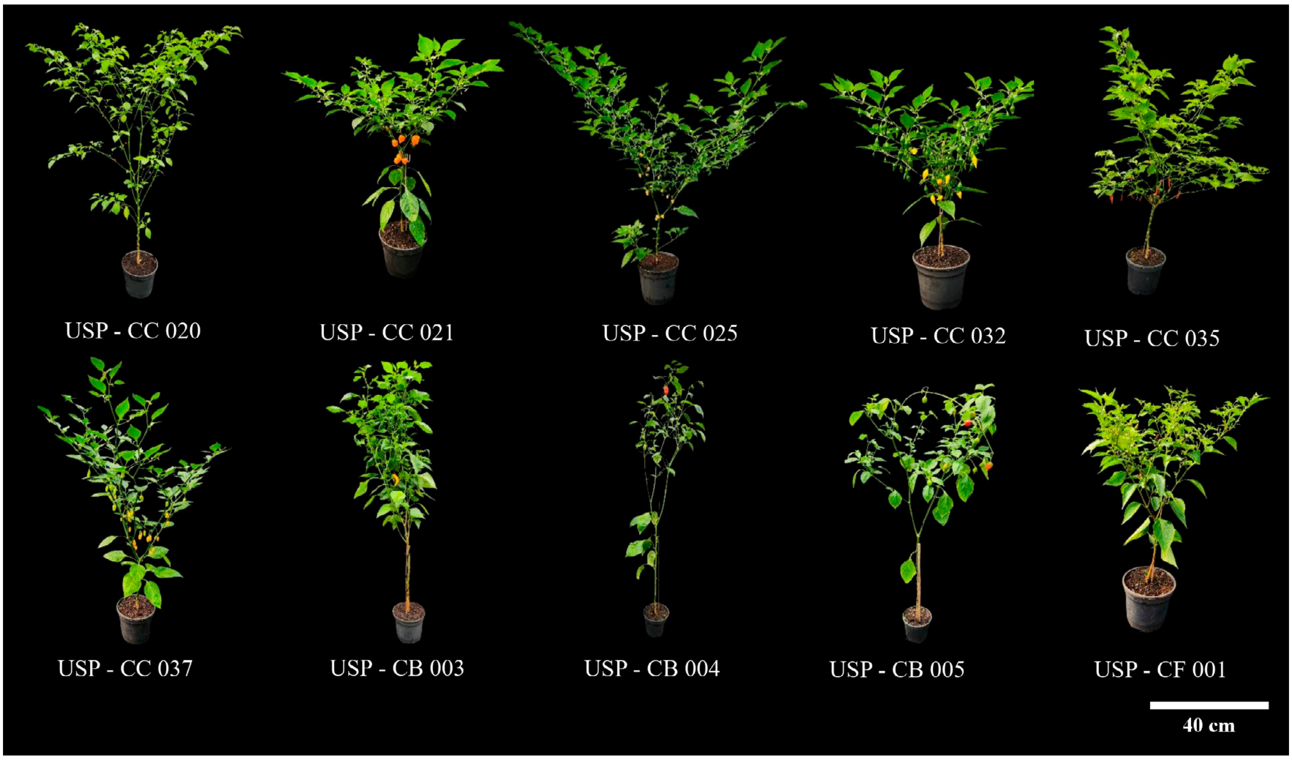

Fig. 5B. Morphological aspects of *Capsicum* spp. genotypes cultivated in pots, belonging to the Active Germplasm Bank of the Luiz de Queiroz College of Agriculture, University of São Paulo.

The genotypes belonging to the species *Capsicum annuum*, *C. baccatum*, *C. chinense*, and *C. frutescens* exhibited morphological diversity expressed through differences in vegetative and reproductive traits. The images allow visualization of variations in plant stature, a characteristic evaluated as an important attribute for selecting materials intended for the ornamental plant market. By selecting plants with reduced stature, it is possible to associate specific crop management practices and plant breeding methods to obtain improved cultivars (Ferreira et al., 2025; Gomes et al., 2025).

Other important attributes for the selection of new materials that justify the choice of the genotypes USP CA 010, USP CA 023, USP CA 028, and USP CA 044 include leaf density, which contributes to canopy formation and to the efficiency of pot coverage, adding ornamental potential and enhancing consumer appeal in the plant market (Cavalcanti et al., 2024).

The diversity observed among the genotypes of the four different species enables the selection of plants with both food and ornamental potential. In addition, tall plants such as the genotypes USP CB 003, USP CB 004, and USP CB 005 can be used in productive gardens, as they are native to Brazil and exhibit greater resistance to cultivation environments.

The fruits of the genotypes analyzed exhibited diversity in shape, including elongated, conical, rounded, and bell-shaped types. In addition, distinct colors of immature and mature fruits were observed, which contrasted with the coloration of vegetative structures, adding ornamental value. However, for the genotypes to be considered ornamental, other attributes must also be taken into account, such as plant stature, flower coloration as secondary attributes, and stem support, which ensures plant stability and sustains the weight of the fruits (Costa et al., 2019; Ribeiro et al., 2024).

In this context, the genetic variability among the 30 genotypes studied, belonging to the species *Capsicum annuum*, *C. baccatum*, *C. chinense*, and *C. frutescens*, is relevant to the field of horticulture, contributing to studies on the nutritional value of peppers, plants with multiple uses, and the potential of materials suitable for genetic improvement, aiming to obtain plants that combine a greater number of desirable traits, as well as to research on the conservation of plant genetic resources.

Conclusions

The characterization based on descriptors revealed wide morphological variability among the *Capsicum* spp. genotypes, allowing the identification of more promising materials for genetic improvement programs, with the aim of selecting them for introduction into the ornamental plant market and contributing to the diversification of products in this segment.

Four genotypes stood out for their ornamental potential USP CA 010, USP CA 023, USP CA 028, and USP CA 044 because they combine desirable characteristics such as compact growth habit, contrast between leaves and fruits, and high visual attractiveness, indicating strong potential for commercial exploitation.

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Author Contribution

HSB: Conceptualization, Methodology, Investigation, Formal Analysis, Writing - Original Draft**. CFMM:** Supervision, Project Administration, Writing - Review & Editing**. JAMT:** Formal Analysis, Writing - Review & Editing. **FAP:** Funding Acquisition, Project Administration and Writing - Review & Editing.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability Statement

Data will be made available upon request to the authors.

Declaration of generative AI and AI-assisted technologies in the writing process

The authors declare that no generative AI tools and AI-assisted technologies were used in the writing and development of this manuscript.

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