



Aechmea distichantha Lem. (Bromeliaceae): postharvest durability and potential as ornamental cut flower¹

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ABSTRACT

The cut flowers segment has an important share in the Brazilian floriculture market. However, most of the species traded are exotic because of the severe lack of information about the ornamental potential of the Brazilian flora. On the other hand, a trend observed in landscaping and floriculture is the use of native species, leading to their conservation, propagation and valuation. This study aimed to analyze the potential of *Aechmea distichantha* Lem. (Bromeliaceae), a species native to Cerrado and Atlantic Forest, as ornamental cut flower by evaluating postharvest durability, as well as morphometric and aesthetic parameters. Floral scapes were harvested and kept in containers with tap water. Morphometric measurements, evaluation of commercially important esthetic parameters, and monitoring of postharvest durability were performed. In addition, an online questionnaire was applied to potential consumers to assess the acceptance of the species as a cut flower. The vase life of *A. distichantha* floral scapes was 10.1 ± 1.5 days, which in addition to size, shape, structure, colors, and originality make them commercially viable as cut flower. The species was accepted by more than 90% of the potential consumers assessed. Therefore, *A. distichantha* has great potential for the cut flowers market.

Keywords: Brazilian flora; floral arrangement; floral scape.

INTRODUCTION

The Brazilian floriculture market has increased sales from 8.3% to 15% per year between 2008 and 2013 (Sebrae, 2015). In the following years, this market continued to expand, presenting a growth of 10% in 2018 and total sales of R\$ 8.1 billion (Enflor, 2019). The production of cut flowers in this market, in 2013, concentrated 34.3% of the total financial movements in the sector. In Brazil, there is no precise data on the exotic and native plants cultivated. However, it is a fact that, among cut flowers, there has always been a preference for the production of exotic species such as roses, carnations, lisianthus, and lilies (Sebrae, 2015), in a disregard for the potential of the vast diversity of the Brazilian flora, with 37,732 species described so far (Forzza *et al.*, 2020).

On the other hand, the flower and landscaping market tends to reduce the use of exotic species, replacing them by native species with ornamental potential, mainly aiming at the conservation and valuation of the native flora (Heiden *et al.*, 2006). To increase the use of native species as cut flowers, studies on domestication, large-scale production, ornamental potential and postharvest durability are needed. Among the prerequisites for a plant to be considered suitable for commercialization as a cut flower, important characters are aesthetic aspects and postharvest durability (Rafdi *et al.*, 2014).

Bromeliaceae family comprises 77 genera and 3,627 species (Gouda & Butcher, 2020). In Brazil, 1,400 species occur in several biomes and diverse phytophysiognomies (Forzza *et al.*, 2020). Bromeliaceae have been economically

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used as a source of fibers, food, fuel, medicine and as ornamental plants (Benzing, 2000), moving an international multi-million market. In Brazil, mainly from the 1990s onwards, species from this family, such as *Aechmea fasciata*, *Aechmea blanchetiana*, and *Guzmania ligulata* started to be produced and commercialized on a large scale with high consumer acceptance.

Aechmea distichantha Lem. (Bromeliaceae) (Figure 1) is an epiphytic, rupicolous or terricolous plant with green, spined, long, erect to arched leaves and a compound inflorescence (raceme of spikes) with pink or red bracts and blue or lilac flowers, pollinated mainly by butterflies and hummingbirds (Scrok *et al.*, 2011). The fruits are spread by small mammals. It blooms from June to September and bears fruit from December to April (Fischer, 1994). *A. distichantha* occurs in Bolivia, Paraguay, Argentina, Uruguay, and in the southeast and south of Brazil (Smith & Downs, 1979).

Preliminary subjective evaluations suggest that the floral scape of *A. distichantha* can be used as a cut flower, as it seems to have the necessary aesthetic characteristics for this intent. Thus, the present study aimed to evaluate the ornamental potential of the *A. distichantha* inflorescence as cut flower and its postharvest durability.

MATERIAL AND METHODS

Collection and storage of floral scapes

The *A. distichantha* population was selected from a basaltic outcrop located on the edge of the PR445 highway, in the municipality of Londrina, PR, Brazil (23°35'16.41"S, 51°6'57.09"W). The population was formed by hundreds of individuals, with nearly half of them blooming at the collection time. At the beginning of September 2019, thirty floral scapes were collected by gently pulling with hands to detach them at the base, without damage. After collection, the scapes were taken

immediately to the Laboratory of Plant Morphology of the Universidade Estadual de Londrina (UEL), and placed in containers with tap water, which was replaced every 2 days.

Morphological and color characteristics

A morphological and morphometric description of floral scapes was carried out using a measuring tape and a pachymeter to measure (cm) the total length of the structure and inflorescences and diameter of scapes and inflorescences. Colors of components of the floral scapes were described in detail, using the Pantone® Color Systems (Pantone, 2021a). For this purpose, the smartphone app Pantone® Connect and the Pantone® Color Match Card were used, allowing, with a smartphone camera, to capture, measure and match colors of objects, raw materials and surfaces, indicating a specific Pantone® color as a reference, while also providing matching in the CMYK-type color scale (Pantone, 2021b), which matches the cyan (C), magenta (M), yellow (Y) and black (K) colors (Elme & Faria, 2001).

Evaluation of postharvest performance

To assess the durability of the floral scapes, a methodology based on a grade scale and senescence was applied (Table 1), according to Pulido *et al.* (2017), with modifications. Daily, floral scapes were observed, photographed and postharvest evaluation criteria were measured through the assignment of grades, according to the visual characterization of senescence symptoms. Commercial durability is established when the grade is equal to or greater than 3 (Pulido *et al.*, 2017).

*Evaluation of the potential of *A. distichantha* as a cut flower*

To assess the commercial viability of the species as a cut flower, a methodology developed by Stumpf *et al.*



Figure 1: *Aechmea distichantha* (Lem) in its natural habitat, Londrina, Paraná, Brazil.

(2007), with modifications, was applied. A spreadsheet (Table 2) was created with qualitative and quantitative characteristics relevant to flower art and the consumer market, with scores assigned to each characteristic (0, 5, or 10). Each one was scored by five examiners from the study group on the ornamental potential of Brazilian native flora, in association with the Laboratory of Plant Morphology (UEL). After each characteristic is scored, the floral scape is classified based on the total sum: A) above 70: high ornamental potential; B) between 51 and 70: medium ornamental potential; C) between 26 to 50 points: low ornamental potential; and D) 25 points or less: minimal ornamental potential.

Acceptance assessment of *A. distichantha* as a cut flower by potential consumers

An online questionnaire (Google Forms) with a brief description and images of the species emphasizing the floral scape was created and sent by e-mail and social networks to invite the public to participate. Eventually, 64 participants were interviewed responding “yes” or “no” to the following questions: 1) Do you think the floral scape of *A. distichantha* is beautiful? 2) Do you think the floral scape of *A. distichantha* is original? 3) Do you think the floral scape of *A. distichantha* could be used as a cut flower in flower arrangements? A field for additional comments was added at the end of the questions.

RESULTS AND DISCUSSION

Morphological and color characteristics

Floral scapes are erect or slightly arched, stiff and resistant to permanent bending, with dimensions described in table 3. According to market quality standards, cut flowers must have straight or almost straight scapes to support the flowers, since strongly arched scapes can bend or break, and provide non-uniform lots and, therefore, undesirable for floral arrangements (Ibraflor, 2020). Moreover, stiff floral scapes have greater versatility for use in different types

of compositions, bases and containers, without the need for reinforcement with tutors (Kikuchi, 1995); and are more resistant to handling and transport (Chamas & Mathes, 2000). In this way, the straight or slightly arched and stiff floral scapes of *A. distichantha* are highly valued for their architectural characteristics. The average total length (Table 3) was also satisfactory, as it allows multiple forms of use in floral compositions, since floral scapes with greater length enable the creation of long-lined arrangements, with good verticality (Stumpf *et al.*, 2009). Chamas & Matthes (2000) pointed out that 20 cm in length is the minimum viable length for making floral arrangements. On the other hand, Castro *et al.* (2011) classified floral scapes according to the total length into short (d” 80 cm), medium (81 - 160 cm), tall (161 - 240 cm), or giant (e” 241 cm), thus *A. distichantha* scapes are classified as medium size, which makes them suitable for using as a cut flower.

The floral structures of *A. distichantha* has a unique color combination. The scape is pink (Pantone® 211C; CMYK 0-60-0-0) in its median portion, with white scales towards the base and a predominance of white in this region. Scales become rare towards the apex and expose a hot pink (Pantone® 212C; CMYK 0-78-2-0) hue in the most apical regions. The scape supports a hot pink (Pantone® 212C; CMYK 0-78-2-0) inflorescence composed of hot pink (Pantone® 212C; CMYK 0-78-2-0) floral bracts and flowers with purplish blue (Pantone® 3583C; CMYK 84-100-0-6) petals (Table 3). The presence of contrasting colors results in great prominence and originality of the inflorescence as a whole. The colors in landscaping, floral arrangements, and as decoration elements can reflect emotional and visual effects such as calmness, distance, and depth with cool colors, and excitement, joy, luminosity, and closeness with warm colors (Leal & Biondi, 2006). Thus, structures with conspicuous colors become attractive from the market point of view, as they are desirable for the establishment of different emotional and visual effects. This is the main

Table 1: Criteria, grades and technical specifications for postharvest durability evaluation of *Aechmea distichantha* floral scapes (Pulido *et al.*, 2007). Each criterion was scored by grades (1: minimum - 4: maximum)

Criterion	Grade 4	Grade 3	Grade 2	Grade 1
Color	colorful/Strong	medium-colored	discolored	very discolored
Brightness	with brightness and no dryness at the bracts ends	with brightness and light dryness at the bracts ends	with light brightness and dryness at the bracts ends	with no brightness and dryness at the bracts ends
Turgidity	turgid	averagely turgid	slightly turgid	wilted
Presence of injuries	< 5% with injury	< 10% with injury	< 30% with injury	> 30% with injury
Stiffness	hard	moderately hard	slightly flexible	flexible
Commercial perception	excellent	good	regular	bad

Table 2: Characteristics of interest for floral art and consumer market. Evaluation criteria and scores to be assigned to each of the floral scape characteristics of native and unconventional species (Adapted from Stumpf *et al.* 2007)

Evaluation criterion and characteristic	Score		
	0	5	10
Total length of structure	< 20 cm	20 - 40 cm	> 40 cm
Scape stiffness - Related to the need for support	Flexible	Semi-rigid	Rigid
Scape aesthetic value (only the scape, not consider the inflorescence) - Related to the visual effect or aesthetic value that the scape provides to flower composition	Negative, it must be hidden in the composition	Neutral	Positive, it can be evidenced in the composition
Aesthetic value of inflorescence - As the main aesthetic element of the floral scape, related to the visual effect or aesthetic value that the inflorescence provides to flower composition	Secondary contribution to the composition	Contribution depends on the combination with other elements of the composition	Unusual contribution, adds value to the composition
Value in the floral composition - Related to the volume that adds to floral composition	Low, contributes little to the volume of composition	Medium, contributes moderately to the volume of composition	High, contributes a lot to the volume of composition
Color and/or glossiness - Found in the structure of greatest interest	Secondary contribution to the composition	Contribution depends on the combination with other elements of the composition	Unusual contribution, adds value to the composition
Aroma - Related to the sensation caused in the observer	Unpleasant	Scentless	Pleasant
Originality - Compared with species already commercialized		There is a similar on the market	There is no similar on the market
Postharvest durability- Aesthetic characteristics of interest	< 10 days	10 - 15 days	>15 days

characteristic of floral art, which is the making of balanced sets using flowers, leaves and other plant elements, to convey feelings (Thomas *et al.*, 1998). Still, the originality of the shapes and the arrangement of the colors presented is also important (Scace, 2001), since the market is always eager to offer novelty products with a differential advantage that can win over consumers. Thus, for the floral scapes of *A. distichantha*, the presence of very colorful structures, with contrasting colors, such as hot pink bracts and purplish blue petals, may work as a commercial advantage for attracting the consumer due to its originality.




Postharvest performance

The daily monitoring of scape senescence showed that they had a vase life of 10.1 ± 1.5 days while retaining their aesthetic value, corresponding to the stage IV of the senescence scale and grade 3 of the grade scale (Figure 2), after which bracts become discolored, wilted,

and wrinkled, not being suitable for trade as an ornamental structure. According to Chamas & Matthes (2000), flower structures with vase life of more than 4 days are suitable for use as cut flower. On the other hand, Stumpf *et al.* (2007) discussed that vase life duration of 10 days is an acceptable performance, therefore, suitable for use as a cut flower. Castro *et al.* (2011) proposed that scapes lasting longer than 20 days are classified as long vase life; between 10 and 20 days, average vase life; and less than 10 days, short vase life. The authors suggest that average- or long-vase-life scapes are suitable for the market, as they provide adequate time for harvest, storage, transportation, trade, and consumption.

During the monitoring period, the average temperature recorded was 25.6 °C, with average daily maximum temperature and average daily minimum temperature of 32.9 and 18.4 °C, respectively. In addition, the average relative humidity recorded was 60.7%, with maximum daily

Table 3: Morphometric and color characteristics measured in floral scapes of *Aechmea distichantha* Lem.

Characteristics	Dimension (cm)		
Average length			
Total structure	93 ± 15.1		
Inflorescence	20.3 ± 4.3		
Average diameter			
Scape	1.6 ± 0.4		
Inflorescence	9.6 ± 2.4		
Color	Pink	Hot pink	Purplish blue
Pantone® Color Systems	211C	212C	3583C
CMYK	0-60-0-0	0-78-2-0	84-100-0-6
			

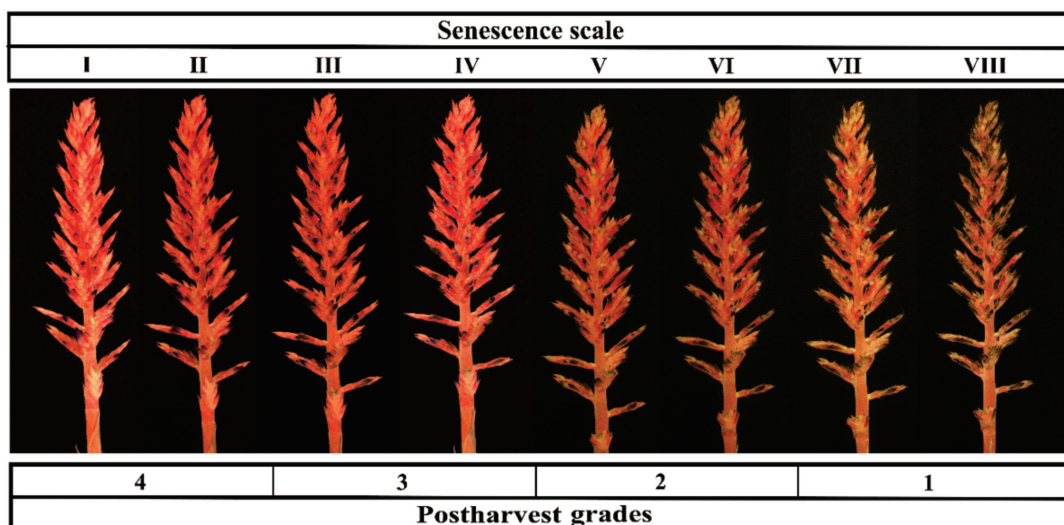


Figure 2: Senescence scale and grades for postharvest durability evaluation of *Aechmea distichantha* floral scapes.

average and minimum daily average humidity of 84.1 and 37.3%, respectively (Simepar, 2021). However, keeping the floral scapes in a milder temperature and higher humidity gives a more efficient control of water loss through transpiration, reduction in respiration, and decrease in infection rates and pathogen development, increasing the durability of floral scapes (Lima & Ferraz, 2008).

Potential as a cut flower

The methodology of Stumpf *et al.* (2007) allowed the evaluation of important morphological and aesthetic characteristics of the floral scape. The total length of the floral scapes of *A. distichantha* was above 40 cm and are rigid enough to dispense with the use of supports, being assigned a score of 10 for Total Length of Structure and Scape Stiffness. The Scape Aesthetic Value was considered element of little visual interference in the set, not adding significant value to floral compositions, but not impairing them aesthetically. On the other hand, the inflorescence presents dimensions and colors that make them capable of provoking positive effect and adding aesthetic value to floral compositions, being the main aesthetic element of

the floral scape. Thus, scores 5 and 10 were assigned, respectively, for these characteristics (Table 4).

Due to its total dimensions, floral scapes of *A. Distichantha* contribute significantly to the yield of floral compositions, making the arrangements more bulky. For this reason, score 10 for Value In The Floral Composition was assigned. The floral scapes have vibrant and original color, but do not give off any type of odor capable of causing any sensation in the observer, therefore receiving a grade of 10 and 5, respectively, for Color and/or Glossiness and Aroma (Table 4).

Despite the ornamental potential of its floral scapes, Bromeliaceae species present incipient production and commercialization in the Brazilian cut flower market (Sebrae, 2015); not existing in this market species that show morphological and aesthetic attributes similar to those presented by the floral scapes of *A. distichantha*, justifying a maximum score for the Originality characteristic. Finally, the Aesthetic Characteristics of Interest of this species presented postharvest durability between 10 and 15 days, receiving a grade of 5 for this characteristic (Figura 2, Table 4).

The total score summed up 75 (Table 4), which points to a high ornamental potential and viability of using the floral scape of *A. distichantha* as a cut flower. Other studies, using the same methodology, managed to assess the ornamental potential of several native species in Brazil, including *Andropogon bicornis* L., which scored 95, demonstrating a high ornamental potential (Stumpf *et al.*, 2009); and *Baccharis articulata* (Lam.) Pers., *B. usterii* Heering, *Eryngium ebracteatum* Lam., *E. eriophorum* Cham. and Schldtl., *E. sanguisorba* Cham. and Schldtl., *Hypericum connatum* Lam., *Limonium brasiliense* (Boiss.) Kuntze, *Myrsine umbellata* Mart., *Schinus lentiscifolius* Marchand, and *S. terebinthifolius* Raddi, which scored above 70, presenting, therefore, a high ornamental potential for the use of their scapes as cut flower (Stumpf *et al.*, 2007).

Table 4: Score averages assigned by five evaluators to characteristics of ornamental interest in floral scapes of *Aechmea distichantha* Lem. (Adapted from Stumpf *et al.* 2007)

Characteristics	Score average
Total length of structure	10
Scape stiffness	10
Scape aesthetic value	5
Aesthetic value of inflorescence	10
Value in the floral composition	10
Color and/or glossiness	10
Aroma	5
Originality	10
Postharvest durability	5
Total	75

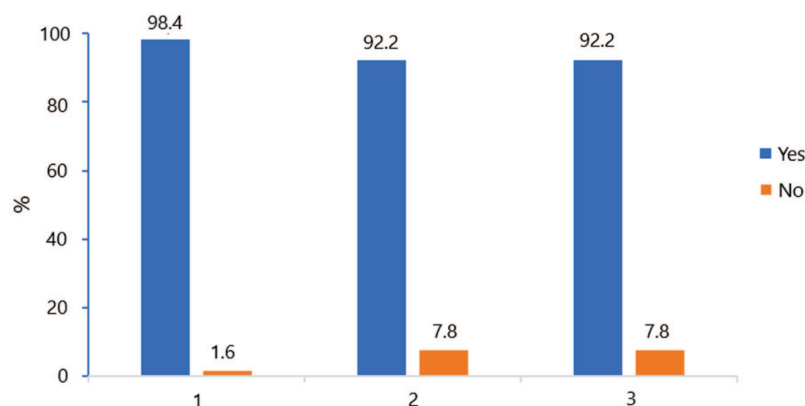


Figure 3: Evaluation of *Aechmea distichantha* acceptance as a cut flower by potential consumers. Questions: 1) Do you think the floral scape of *A. distichantha* is beautiful? 2) Do you think the floral scape of *A. distichantha* is original? 3) Do you think the floral scape of *A. distichantha* could be used as a cut flower in flower arrangements?

Assessment of consumer acceptance of *A. distichantha* as a cut flower

Beauty and originality, according to Scace (2001), are among the most important criteria for consumers purchasing cut flowers. Thus, in this assessment, these factors were considered in making questions to this group. During this study, 64 potential consumers accessed the questionnaire online and answered the questions. Among them, 98.4% of considered the floral scape of *A. distichantha* as beautiful; 92.2% as original; and 92.2% considered that it could be used as a cut flower. Thus, showing that *A. distichantha* floral scape had more than 90% of acceptance as a cut flower by potential consumers (Figure 3). Using a similar methodology, Stumpf *et al.* (2007) assessed 11 native species for the suitability of using them as cut flowers. Consumers, researchers, and professionals related to floral art and landscaping carried out 79 evaluations, using an online questionnaire. Among the 11 species, 10 were classified as having high ornamental potential and being suitable for use as cut flowers. It is essential that native ornamental species of potential use as cut flower be assessed by potential consumers, as they are the basis for any commercial enterprise. The results of this study, using methodology corroborated by other authors, show that the use of *A. distichantha* as cut flower is accepted by potential consumers.

CONCLUSIONS

Floral scapes of *A. distichantha* have high ornamental and commercial potential for use as cut flower in floral arrangements, possessing desirable characteristics from the points of view of structure, conservation, and commercial appeal. The demonstrated durability ensures adequate time for harvest, storage, transportation, trade and, after sales, exposure time in floral arrangements. The size, architecture, resistance to folding, colors, beauty, and originality make it suitable for floral arrangements and attractive to consumers in general. This conclusion is supported by the interviews with potential consumers who showed great acceptance of the use of *A. distichantha* floral scape as a cut flower. Finally, it must be emphasized that the intent of this work is not to encourage overexploitation, but to underline the economic potential of the species, which may further studies and initiatives related to its propagation and commercial production as a new economically viable alternative for the cut flowers market. In the same manner, species that are widely propagated commercially become more available in the market and more common in gardens, reducing the overexploitation of their natural populations.

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