Evaluation of potential use of native *Anthurium* foliage[1]

ERICA BARROSO MORAIS[2], ANA CECILIA RIBEIRO DE CASTRO[2]*, FERNANDO ANTONIO DE SOUZA ARAGÃO[2], TIAGO FREITAS SILVA[3], NAZARÉ SUZIANE SOARES[3] and JOCILENE PINHEIRO DA SILVA[3]

ABSTRACT

The Brazilian flora has a large number of species with ornamental potential. These species are poorly recognized or even completely unexplored. The objective of this study was to evaluate the potential use of four accessions belonging to the species of *Anthurium plowmanii, A. raimundii, A. bonplandii* and *A. Affine* for cutting foliage. The accessions from Embrapa Germplasm Bank of Tropical flowers were evaluated for 21 morphological and phenological characteristics and post-harvest longevity. The ornamental characterization was based on the evaluation of this data and florist acceptance as well. The accessions presented differences in almost all the characteristics related to the morphology of the inflorescence and the leaf. Some characteristics such: fruit color, petiole, spadix, and spathe length, are highly variable within the species and depend on the developmental stage. Some characters like petiole length and inflorescence position are particularly important as indicators for the use as cut foliage. The plants have slow development as typical from members of this family and and the production of leaves per year ranged between 6.6 (*A. plowmanii*) to 10.5 (*A. bonplandii*), which might be increased with the improvement of cultivation aspects, with an emphasis on spacing, plant management and fertilization. The leaves of *Anthurium plowmanii, A. raimundii, A. bonplandii* and *A. affine* present high postharvest durability and great potential as cut foliage, possessing florist acceptance as well.

Keywords: cut foliage, germplasm bank, floral arrangement, and postharvest durability.

RESUMO

Avaliação do Potencial de uso de espécies nativas de *Anthurium* para folhagem

A flora brasileira tem um grande número de espécies com potencial ornamental, muitas dessas são pouco reconhecidas ou inexploradas. O objetivo deste trabalho foi avaliar o uso potencial de quatro acessos pertencentes às espécies de *Anthurium plowmanii, A. raimundii, A. bonplandii e A. Affine* para produção de folhagem de corte. Os acessos pertencentes ao Banco de Germoplasma de flores tropicais da Embrapa foram avaliados quanto a 21 características morfológicos e fenológicos, bem como a longevidade pós-colheita e potencial ornamental, baseado na aceitação de floristas. Os acessos apresentaram diferenças significativas em quase todas as características relacionadas com a morfologia da inflorescência e da folha. Algumas características tais: cor de fruta, pecíolo, espádice e comprimento espata, são altamente variáveis entre e dentro dos acessos e dependem do estágio de desenvolvimento. As caracteristicas comprimento do pecíolo e longevidade pós-colheita são particularmente importantes como indicadores para a utilização como folhagem de corte. As plantas têm desenvolvimento lento como típico de membros desta família, e a produção de folhas medio por ano variou entre 6,6 (*A. plomanii*) a 10,5 (*A. bonplandii)*, o que talvez possa ser incrementado com o aprimoramento dos aspectos de cultivo, com ênfase no espaçamento, manejo da planta e adubação. As folhas de *A. plowmanii, A. raimundii, A. bonplandii* e *A. affine* apresentaram alta durabilidade pós-colheita e de grande potencial como corte de folhagem, possuindo também aceitação florista.

Palavras-chave: folhagem de corte, banco de germoplasma, arranjos florais, durabilidade pós-colheita.

1. INTRODUCTION

Given the increased demand for flowers and ornamental plants, both in the domestic and international market, the Brazilian floriculture has expanded. Within this segment, the foliage, leaves and fresh branches, of tropical species have shown great potential for future export growth, with remarkable and outstanding quality, beauty and durability. The productive sector of cut foliage and its use in bouquets has increased considerably over the last 15 years (about 20-25%) and the tendency is to increase further (BERUTO, 2013).

The Brazilian flora has a large number of species with ornamental potential. These species are poorly recognized or even completely unexplored. The use of native ornamental species could be a future alternative product for Brazilian floriculture, following a trend of ornamental market that is characterized by the search for innovation. The use and enhancement of biodiversity

DOI: http://dx.doi.org/10.14295/oh.v23i1.949

(1) Received in 30/08/2016 and accepted in 04/11/2016.

(2) Embrapa Tropical Agroindustry, Fortaleza-CE, Brazil. *Corresponding author: cecilia.castro@embrapa.br

(3) Ceará Federal University, Agronomy Department, Fortaleza-CE, Brazil.

leads to preservation (STUMPF et al., 2015). The lack of knowledge about native species set up an inappropriate use of genetic resources with greater economic appeal. Some species have a limited use, which is often essentially extractive. Consequently, these species can have uncontrolled exploitation and consequent genetic erosion (CASTRO et al., 2010).

In Brazil, the cultivation of *Anthurium* cutting foliage is recent and limited to a small number of species (PESSOA et al., 2013). Some of these species are indiscriminately extracted from nature; others are cultivated in small quantities, mostly in natural shade, not offering standardization and quality needed for economic exploitation. *Anthurium* (*Anthurium* spp.) is an ornamental that is widely appreciated around the world (SILVA et al., 2015) and many species with beautiful features are not under cultivation, being lost due to the lack of research, production system (ALBUQUERQUE et al., 2013). They are appreciated by the effect and shape of its leaves, the eccentric vein design in contrast to the leaf blade color that can range from light green to dark green, smooth or velvety.

Among other conditions, the sustainable commercial exploitation of these species depends on their biological knowledge. To explore and conserve, it is necessary to increase efforts on genetic resources, biodiversity and conservation, associated to bio-prospection and management of plant genetic resources at first. Furthermore, this will permit the valuation and selection of ornamental promising germoplasm and development of production system (ROMÃO et al., 2015).

In this sense, the Embrapa Tropical Agroindustry has a collection of anthuriums with ornamental potential with currently 53 accessions of *Anthurium* collected in Brazil. Little is known about morphological and phenological characteristics and postharvest durability of these materials. This knowledge is essential for the initial use of the accessions in breeding programs that can introduce these plants in the market. With this vision, we characterized four accessions of *Anthurium* from Embrapa's collection for their ornamental potential. We evaluated morphological, phenological and post-harvest data and florist acceptance in order to identify the potential use of this material for floriculture.

2. MATERIALS AND METHODS

The experiment was conducted in an 80% sun blocker shade house, from February 2009 to july 2010. The accessions belong to the species *Anthurium plowmanii* Croat, *A. raimundii* Mayo, Haigh & Nadruz, *A. bonplandii* and *A. affine* Schott (Figure 1). They were selected from the Araceae collection from the Active Germplasm Bank (BAG) of Flowers and Ornamental Plants of Embrapa, with promising characteristics for ornamental use.

The two years old plants were grown in beds with 1.50 m wide with commercial substrate rich in organic matter, spaced 0.30 x 0.30 m between plants. The local coordinates are 03º45'05"S, 38º34'36"W. The regional climate is tropical and the yearly total rainfall average is approximately 600 mm. The irrigation was provided by a supplementary daily sprinkler system. Solid fertilizer containing 6% of N; 18% of P_2O_5; 12% of K_2O; was applied monthly at a rate of 30g/m^2. The experimental design was completely randomized with five replications (plants), each accession was considered a treatment. Old leaves and invasive plants and were taken periodically as needed.

The morphological characterization of the plants was carried out by means of morphological descriptors prepared from CATE-ARACEAE database (REYNOLDS et al., 2009). The evaluations were performed weekly (CASTRO et al., 2010). The measurements were made with caliper and tape.

For the color ratings, fully expanded leaves were measured using colorimeter MINOLTA CR-300, which expresses the color of three L, which corresponds to the luminance (brightness, lightness or reflectance; 0 - dark / opaque and 100 - white); where the direction + A is red and -A is green (ranging from +60 to -60), B + the yellow direction, and -B the blue direction (ranging from +60 to -60). The leaves were submitted to a comparative classification of the color intensity and leaves were kept in test tube with water at ambient temperature at levels brightness of 15 μM m^{-2} s^{-1} immediately after cutting (in the most basal part of the stem) for postharvest evaluation. The evaluations were made three times a week until the observation of the onset of senescence. The disposal was made when the leaves were more than 10% yellowing.

The following morphological characters were observed in each plant, being considered relevant for indication use as cut foliage: plant height (measured from the ground level to the highest part of the plant); stem habit; root arrangement; persistence of cataphylls (intact persistent, deciduous or persistent as fibers), length (distance between the insertion of two consecutive leaves) and diameter of the internode (in the middle portion of the stem), blade shape and undulation (absent, low, medium or high) and color; blade cut; presence or absence of peltate leaf; blade length, width (middle portion, wider) and texture; length and diameter of the petiole (the middle portion); pulvine length and color; postharvest longevity of leaves; inflorescence position (below, equal or greater than the height of the leaves); color and shape, length and width of the spathe; color of immature and mature spadix and fruit color. For the traits blade lenght, blade width, petiole length, petiole width, internode lenght, internode width, spathe lenght, spathe width, pulvine length, plant height, color, postharvest durability descriptive statistics were calculated.

The following phenological plant traits, which are important for use as cut foliage were observed: leaf production (average number of leaves produced per year); flower production (number of days for a new inflorescence to grow from its associated leaf); time for maturation of the gynoecium (from the inflorescence opening day); time for maturation of the androecium (from the inflorescence opening day).

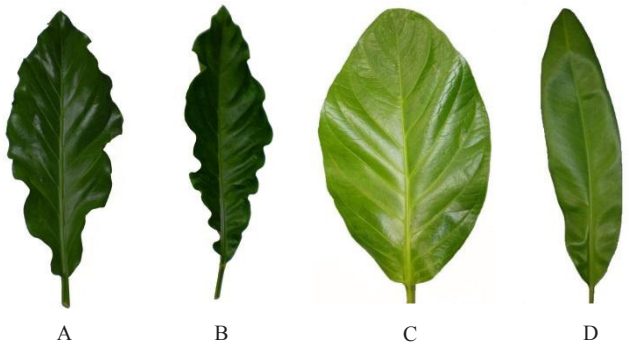

Figure 1. Leaves of *A. bonplandii* (A), *Anthurium raimundii* (B), *A. affine* (C) and *A. plowmanii* (D)

For ornamental characterization as cut foliage, an adaptation of the criteria proposed by Stumpf (2007) was made from the analysis of qualitative and quantitative characteristics of importance for floral art and the consumer market for ornamental characterization as cut foliage (Table 1). Leaves from *Anthurium plowmanii, A. raimundii, A. bonplandii* and *A. affine* were collected in size supposedly suitable for floral composition, fully-expanded. Each species was evaluated separately. Questionnaires were filled by 6 volunteer florists. The criteria were determined for decoration in general arrangements. For each of the characteristics were given notes 0 (zero), five (5) or ten (10). Previously, the determination of postharvest durability of stems kept in water durability was performed under notes criteria.

The degree of ornamental potential of the species was determined using the sum of the given ratings to the traits evaluated (modified Stumpf, 2007), were considered a greater number of characteristics in relation to the mentioned work was considered in this study, making necessary numerical change in the classification of potential. The endnotes (Table 1) are the average of the grades given by the florists. Averages were calculated from the grades given to the questionnaires to obtain the endnotes presented. The classification of the calculated potential was: Above 84 points - high ornamental potential; Up to 60 to 84 points - average ornamental potential, Over 30 to 60 points - low ornamental potential; 30 points or less - Minimum ornamental potential.

3. RESULTS AND DISCUSSION

There is a great variability in between and within the accessions regarding the morphological characteristics of the leaves, spathe and post-harvest durability (Tables 2 and 3). All the accessions have symmetrical leaves with non-peltate blades, short erect stem habit, dense root arrangement and persistent cataphylls as fibers. Features as symmetry and basal insertion of the petioles (non-peltate) were highlighted as important to the stem use and fit in floral arrangements.

We found that the appearance of the pulvinus has not much importance for ornamental purposes, as it cannot be seen in most of the floral arrangements. Therefore, it was not considered in the final analysis. Beckmann-Cavalcante et al. (2013) observes that stem appearance was not an element capable to add ornamental value to an arrangement. Often despite being aesthetically beautiful, the pulvine has structural function in the arrangement only.

"Blade length" (Table 3) is a characteristic difficult to evaluate because floral arrangements use materials of different leaf sizes depending on the work being performed. In addition, the plasticity of the blade can be used for manipulating their shape and size.

Some morphological characteristics have relatively high standard deviation, which in many cases may be favorable, as variability in genotype/phenotype is interesting in a germoplasm bank. Characters of the inflorescence varied between individuals of the same accession. It can be a consequence of genetic variability, since the plants were subjected to the same environmental conditions.

The postharvest durability has high standard deviation (Table 3), with exception of *A. affine*. It is pondered that the leaves cutting point that has been set, based on maturity stage (fully expanded leaves), is highly variable. Apparently, the cutting point influenced the durability of the leaves. *A. plowmanii* leaves, as an example, has a variable postharvest life, but the most recently-mature, fully-expanded *A. plowmanii* leaf has the longer postharvest life among others older fully-expanded leaves (ALBUQUERQUE et al., 2013).

The plants presented slow growth when considering the production of leaves. This is a typical characteristic of species belonging to this family. This can be an obstacle to its use in the production of cut leaves, demonstrating the need to enhance this characteristic, through the form of cultivation and/or breeding. Paiva *et al.* (2004) proposed that plants with high leaf replacement rate are the ideal cultivars.

Table 1. Evaluation criteria and notes assigned to each of the characteristics for native flowers and cutting foliage.

Characteristics and criteria of evaluation	Notes		
	0	5	10
Length - Considering the total size of the leaf	Unsuitable for most arrangements	Suitable for various arrangements	Suitable for composing most arrangements
Rigidity of the stem or leaves - related to the degree rigidity of stem	Harmful to floral composition	A slight excess problems or lack of rigidity_	Suitable
Stem appearance - Related to the visual effect that the stalk is capable of eliciting in the floral composition, taking into account attributes such as texture, thickness and color.	Interferes negatively in floral composition, it should not be exposed or put in evidence	Does not interfere with floral composition or does not add value	Interfere positively or adds value to floral compositions or contribute positively to the aesthetic
Leaf shape - Related to visual effects that cause to the floral composition	Not attractive or it is not the main ornamental feature	Common or theenhancement depends on the combination with other elements of the floral composition	Unusual or adds value to floral compositions
Income in floral composition - Related the volume that it adds to floral compositions.	Low, contributes little in the increase of the arrangement volume	Average, contributes averagely to the increase of the arrangement volume	High, it contributes positively to increasing the arrangement volume
Color and/or brightness of the flower or inflorescence, leaf or fruit - Related to the visual effect caused	Not attractive or it is not the main ornamental feature	Common or the enhancement depends on the combination with other elements of the floral composition	Unusual or adds value to floral compositions
Aroma - Related to perception, and sensation caused by the material	Little pleasant	Unscented or negligible	Pleasant, add value to floral compositions
Originality – Compared with species already marketed, traditional		There is similiar material on the market	Does not exist similar on the market
Vase life – Considered by the time in days, from the field collection to disposal	Less than 10 days	Between 10 and 15 days	More than 15 days
Size of the petiole - Related to the possibility of using in vase or floral foam	Small, making it difficult to use	Median, enabling use, but with restrictions	Adequate, offering various possibilities of use.
Blade x petiole ratio – Aesthetic proportion of the size	Disproportional	Median	Proper
Vein – Aesthetic interference that it causes.	Interfere negatively	Does not interfere	Contribute positively to the leaf appearance.

Table 2. Morphological traits of leaves: blade shape and ondulation, pulvine color, and blade texture and fruit color of *Anthurium raimundii*, *A. affine, A. bonplandii* and *A. plowmanii*. Fortaleza, EMBRAPA.

Accessions	Blade shape	Blade undulation	Pulvine Color	Blade Texture	Fruit Color
A. raimundii	Strait	Absent	Yellowish green	Membranous	Purple to dark at apex
A. plowmanii	Elliptical	Very	Yellowish green	Semi-coriaceous	Red to dark maroon at apex
A. bonplandii	Elliptical	Absent	Green	Coriaceous	Purple and purple-brown at anthesis
A. affine	Oval	Medium	Orangish	Coriaceous	Red to dark maroon at apex

Table 3. Morphological traits related to blade length and width, petiole length and diameter, pulvine length, plant height, internode length and diameter, spathe length and width and color width, A axis and B axis of *Anthurium raimundii*, *A. affine, A. bonplandii* and *A. plowmanii*. Fortaleza, EMBRAPA.

Accession	Blade Length (cm)	Blade Width (cm)	Petiole Length (cm)	Petiole Diameter (cm)	Plant Height (cm)	Internode Length (cm)	Internode Diameter (cm)	Spathe Length (cm)	Spathe Width (cm)	Durability (days)	Color Width	Color A axis	Color B axis
A. raimundii	62.60	15.82	13.67	1.07	101.40	0.19	0.45	11.60	3.12	49.60	41.22	-14.05	17.00
A. affine	64.80	26.96	16.08	1.58	96.20	1.16	0.67	8.80	3.31	41.40	45.30	-18.81	23.41
A. bonplandii	59.80	34.04	8.07	1.25	62.60	0.78	0.55	18.50	3.42	123.40	36.31	-12.88	13.07
*A. plowmani*i	89.00	32.94	14.34	1.75	97.60	0.71	0.67	10.72	4.16	80.60	36.79	-16.25	17.68
Maximum	107.0	35.7	17.46	1.85	124	1.30	0.81	24.09	6.37	150	46.66	-22.64	24.77
Minimum	57.0	14.5	6.17	1.02	45	0.14	0.4	7.17	2.50	30	36.1	-9.55	11.31
Average	69.05	27.44	13.04	1.41	89.45	0.71	0.59	12.27	3.50	64.70	39.90	15.50	17.74
IC_{95} (±)	6.69	4.11	1.85	0.15	9.52	0.24	0.05	2.35	0.40	17.44	1.98	1.22	2.00
CV (%)	14.30	8.78	3.96	0.32	20.35	0.51	0.12	5.03	0.85	37.15	4.22	2.61	4.26

IC_{95} – standard deviation with 95% of probability. CV (%) – coefficient of variation.

The production of leaves per year ranged between 6.6 (*A. plowmanii*) to 10.5 (*A. bonplandii*), This trait might be increased with the improvement of cultivation aspects, with an emphasis on spacing, plant management and fertilization, In *Anthurium andraeanum*, for an example, the improvement in the soil organic matter content, stimulated plants growth and yield (LIMA et al., 2016). However, an outstanding aspect of these materials was the postharvest durability superior to 30 days. The slow growth is also very positive for pot plants or landscaping plants due to little hand labor and maintenance that it entails. Especially when considering that a potted plant needs replacement by larger containers while the specimen grows.

All accessions obtained great acceptance by florists regarding their general appearance, and achieved notes high enough to be classified as high ornamental potential (Table 4). The accessions have differences in shape, size, blade undulation, texture, color and brightness that result in different options for composition of arrangements. All materials have good postharvest durability (Figure 2), presenting high DAC (days after the cut): *A. affine* (41.4 DAC), *A. bonplandii* (122 DAC), *A. plowmanii* (80.6 DAC) and *A. raimundii* (22.0 DAC) and maximum score in this regard, which adds value to the product. The longevity of a cut ornamental should be at least two weeks, to be suitable for commercial production (DOLE et al., 2013).

Table 4. Given notes to the ornamental characteristics and potential ornamental degree of *A. plowmanii*, *A. raimundii*, *A. bonplandii* and *A. affine.* Fortaleza, EMBRAPA.

Characteristics	A. *plowmanii*	A. *raimundii.*	A. *bonplandii*	*A. affine*
Length	10	10	10	10
Rigidity of the stem or leaves	7.5	9.17	8.33	6.67
Stem appearance	5.83	10	7.5	9.17
Leaf shape	8.33	10	8.33	10
Income in floral composition	10	10	10	10
Color and/or brightness of the flower or inflorescence, leaf or fruit -	5.83	8.33	10	8.33
Aroma	5	5	5	5
Originality	8.33	9.17	8.33	8.33
Vase life	10	10	10	10
Size of the petiole	5	6.67	7.5	4.67
Blade x petiole ratio	5.83	5	9.17	5.83
Vein	6.67	9.17	9.17	9.17
Total	**88.32**	**102.51**	**103.33**	**97.17**
Ornamental potential	**High**	**High**	**High**	**High**

Descriptions of the characteristics evaluated by species

Anthurium affine (IFT 123)

The cultivated plants have height varying from 78 to 124 cm, short and erect stems, internodes 0.4 to 2.2 cm long and 0.6 to 0.75 cm of diameter, dense root arrangement, persistent cataphylls as fibers, which are shown as a discrete entanglement near the stem, and usually with many roots facing upward (negative geotropism). Oval blade, moderately wavy, serous, (L of 43 to 46.6), intense green (a of -17 to -22.6), chartaceous texture, 59 to 70 cm in length and 18 to 31 cm wide. Petiole 11.77 to 19.96 cm long, and 1.46 to 1.85 cm of diameter. Yellowish green pulvinus, with 1.25 to 2.4 cm in length. Inflorescences much lower than the leaves (half the length of the leaves, equal or smaller than that). Green and oblong spathe, fully expanded, slightly rolled down, with one to two turns and presenting purplish veins, mainly concentrated at the opposite end to the spadix, which increase as the spathe matures, ranging from an organ almost entirely green to almost fully wine with 6 to 9 cm long and 2.6 to 4.1 cm wide. Cylindrical spadix, green when immature and at the maturation of the gynoecium, the flowers matured from base to apex and become yellow to maturation of the androecium. The stigma were green when receptive and the anthers are yellow. The flowers have their mature pistil at about 7 days after opening of the inflorescence and the androecium at about 37 days. The inflorescences appeared in a range from 39.5 to 87 days between one and another and were directly attached to a leaf, which were developed in range 42-63 days between one and another, and showed durability and 39-45 days after the cut. Its fruits were red to dark maroon at apex. The plants cultivated have height varying between 1.0 and 1.85 m and width of 1.88 to 2.51, and produces on average 8.5 leaves per year.

As for ornamental potential, it obtained an average above seven in most of the questions, with the exception of four questions, two of them due to the small petiole, being too small, being difficult to make pot arrangements, leaving also an inappropriate proportion. Paiva et al. (2004) also pointed out that the elongated petioles in leaves of *Anthurium* is a desirable characteristic in selecting plants for cutting foliage. Breeding programs are suggested to increase this feature. There are much longer petioles in other accessions of the species in the BGA, offering tools to improve the feature. Another negative aspect is the low hardness, which makes the foliage susceptible to damage during handling. This, however, was assessed as positive by many florists, since it offers better plasticity to the product. The fourth negative review was the aroma, the species does not have. However, this is considered positive for several florists for the foliage in general.

A very positive aspect the species is the wavy blade, well appreciated by the consulted florists. The beautiful elliptical and plan shape was a positive highlight in the evaluation. According to the work of Paiva et al. (2004) leaves of *Anthurium* with flat blade are ideal. A flat blade enables the use of both sides of the blade (abaxial and adaxial) and various other possibilities of arrangements.

Veins also showed outstanding appearance and a beautiful adornment in the leaf blade. The leaves are very shine, which gave it a beautiful natural glow, eliminating the need to use cleaning products during the postharvest procedures.

This species got score to high ornamental potential (Table 4). The great acceptance by florists as the general appearance, sparked interest in the acquisition and use of this material.

Anthurium bonplandii (IFT 108)

The species presented size medium to large, with height of 34 to 75 cm, erect and short stem, internodes 0.6 to 1.2 cm long and 0.5 to 0.7 cm in diameter, dense root arrangement, and persistent cataphylls as fibers that show up as a tangle near the stem. Elliptical blade, very little wavy, moderately serous (L of 35.6 to 36.6), median green (a of -9.55 to -19.43), presenting coriaceous texture, 55 to 67 cm long and 29.5 to 42 cm wide. Petiole 6.2 to 9 cm long and 0.7 to 1.6 cm in diameter. Light green pulvinus, with 2.6 to 3.4 cm in length. Inflorescences with the same height or higher than the leaves. Lanceolate spathe completely green or with purple veins, fully expanded, moderately twisted, with 11.9 to 24.1 cm in length and 2.6 to 4 cm wide, almost always deciduous before the maturation of the androecium. Spadix intermediate between cylindrical and conical, can be green or purple, slightly modifying the color over maturing, becoming less noticeable as it matures. The stigmata, when receptive are the same color as the tepals and the anthers are yellow. The flowers have their mature gynoecium as soon as they open or up to 2.5 days later, and androecium matures at about 15 to 22.8 days. The inflorescences grew in a range of 98.6 to 143.2 days between each other and are directly associated with a leaf, which were opened in a range of 32.5 to 47.3 days between one and another, and the postharvest durability were 49 to 170 days after cutting. The fruits were purple and purple-brown at anthesis. The plants cultivated have height varying from 0.96 to 1.46 m and width of 1.25 to 1.62 and produces on average 10.5 leaves per year.

The species has the highest ornamental potential, among the studied species. It was highly appreciated by almost all consulted florists, except for a negative evaluation that was about the difficulty in use. The leaves presented note below seven for the characteristic no aroma. The postharvest durability was greatly appreciated by all evaluators. The long petiole and the ratio between it and the blade was the most appreciated characteristic, and among all the evaluated materials, this was the best in this category. This was due to both the good effect of that ratio and the size of the petiole that allows working in a larger variety of compositions. The leaf showed great rigidity, and at the same time plastic, allowing to be bent or flexed. The accessions also are serous, giving certain glow to the product. The intense leaf color was well evaluated and got maximum average.

Anthurium plowmanii (IFT 120)

The species presented height of 76 to 109 cm, short and upright stems, internodes of 0.3 to 1 cm in length and 0.6 to 0.8 cm in diameter, dense root arrangement, and persistent cataphylls as fibers that was shown as a tangle close to the stem. Elliptical blade, very wavy, moderately serous (L of 33.5 to 38.8), intense green (a of -14.1 to -18), semi-coriaceous texture, 67 to 107 cm long and 25.3 to 42.6 cm wide. Petiole 11.6 to 19.8 cm long and 1.6 to 1.8 cm in diameter. Orangish pulvinus with 1.2 to 2.2 cm in length. Inflorescences located below the leaves, with short stem. Lanceolate wine spathe, fully expanded, strongly curled downward, with 6.8 to 17.6 cm in length and 3 to 6.3 cm wide. Spadix intermediate between cylindrical and conical, and may be gray or purple. The stigmata, when receptive, were always purple and the anthers were orange. The flowers often presented mature pistil before the inflorescence was open or up to a day later, and the androecium was matured at about 6 to 36 days. The inflorescences emerged in a range from 84.3 to 165.5 days between each other and were directly attached to a leaf, which grew in the range of 38.3 to 61 days between each other and had durability 47 to 150 days after cutting. The fruits were Red to dark maroon at apex. The plants cultivated have height varying from 1.3 to 1.43 and width of 1.59 to 2.10 and produces on average 6.6 leaves per year.

About the overall look, the species was well appreciated by florists, especially regarding the strong undulation of the limbo. However, it showed less ornamental potential than the others, due to its blade rigidity and closed aspect (convergent blade bases, giving a boat format in most of the leaf), therefore it makes the handling harder during the compositions. These features, however, are extremely favorable in some combinations of arrangements since it gives an unusual and decorative format, as stated by some of the florists. It can be an excellent option for support of bouquets.

The leaves of this species got note below seven also about the question color/brightness, due to its dark green and opaque color. The petiole also performed as a difficulty, because it is small, and disproportionate to the blade. Although the leaf veins were highlighted, they were the same color as the leaf blade.

Anthurium raimundii (IFT 109)

The plants presented height of 88 to 106 cm, short and erect stems, internodes with 0.14 to 0.25 cm in length and 0.6 to 0 8 cm in diameter, dense root arrangement, persistent cataphylls as fibers that are shown as a discrete entangled close to the stem. Straight blade without corrugation, serous (L 38.3 to 43.1), medium green (a -12.5 to -17.2), membranous texture, 56 to 66 cm long and 14.5 to 18.6 cm wide. Petiole 10.4 to 18 cm long and from 1 to 1.15 cm in diameter. Yellowish green pulvinus, 1.5 to 2.5 cm in length. Inflorescences above the leaves. Lanceolate spathe, ranging from green to purplish, fully expanded, inserted at 90° to the spathe, 10.5 to 12 cm long and 2.5 to 3.5 cm wide. Conical spadix, purplish when immature and become dark green as it matures. The stigmas were the same color as the tepals. The flowers presented a mature pistil about 1 to 26 days after the opening of the inflorescence. The androecium was mature at about 17.3 to 49.5 days. Each

inflorescence was directly associated with a leaf which, once cut, occasioned the declining of its inflorescence. The inflorescences were shown 40 to 55.5 days after the growth of its associated leaf, which arrived in a 34.3 range to 44.7 days between each other, and have durability 15 to 49 days after cutting. The fruits were purple to dark purple at apex. The plants cultivated have height varying from 0.54 to 0.86 and width of 0.71 to 1.04 and produces on average 8.5 leaves per year.

Regarding the general appearance, almost all evaluations were positive. The elongated elliptical shape provides versatility in use in different compositions. It was observed that this material had good endurance in arrangements, since it was not very rigid and possessed flexibility during handling. The presence of serous caused brightness. The color was in a less attractive shade of green. The petiole was small, disproportionate to the leaf blade and making it hard to use in some compositions. The evaluated material showed good postharvest durability, which is a differential to the market.

4. CONCLUSIONS

The accessions have desirable ornamental characteristics and can be successfully used as cut foliage in floral arrangements. The four accessions have high ornamental potential for use as cut foliage, especially due to the high durability of the materials.

ACKNOWLEDGMENT

To Embrapa Tropical Agroindustry, Banco do Nordeste do Brasil/FUNDECI, MCT/SEBRAE/FINEP and to CNPq for the financial support and scholarships.

REFERENCES

ALBUQUERQUE, A.C., CASTRO, A.C.R., ARAGÃO, F.A.S., LOGES, V.; MORAIS, E.B. Durability of *Anthurium plowmanii* leaves in different harvest stages. **Acta Horticulturae,** n.1000, p.189-193, 2013.

BERUTO, M. Introduction of new ornamental plants and production techologies: case Studies. **Acta Horticulturae**, n.1000, p.23-34, 2013.

CASTRO, A.C.R, MORAIS, E.B., MOURÃO, I.C.S, CARVALHO, A.C.P.P. Ornamental foliage potential of *Anthurium* acessions. **Acta Horticulturae**, n.855, p.61-67, 2010.

DOLE, J.M., CARLSON, A.S., CRAWFORD, B.D.; MCCALL, I.F. Vase life of new cut flowers. **Acta Horticulturae**, n.1000, p.63-70, 2013.

LIMA, J.D.; ZANETTI, S.; NOMURA, E.S.; FUZITANI, E.J.; ROZANE, D.E.; IORI, P. Growth and yield of *Anthurium* in response to sawdust mulching. **Ciencia Rural**, v.46, n.3, p.440-446, 2016.

PAIVA W.O., CAVALCANTE R.A., BARROS L.M. Melhoramento genético do antúrio no Ceará. **Revista Brasileira de Horticultura Ornamental**, v.10, n.1/2, p.10-14, 2004.

PESSOA, A.C.B.P., CASTRO, A.C.R; GALLÂO, .I. Leaf anatomical characterization of two *Anthurium* species (Araceae) with a high potencial for ornamental purposes. **Acta Horticulturae,** n.1000, p.165-170, 2013.

PETRY, C., TEDESCO, C.T., ABREU, M., ROESSSING-ALOIVISI, M., KUNST-BAROSKY, T., DALLA-RIVA, A., VANIM, J., BRAGA V.B; DALACORTE, L., REMOR, T. Multiple uses of native or hardy low-maintenance plants of the south of Brazil in landscaping. **Acta Horticulturae**, n.1000, p.49-54, 2013.

REYNOLDS, L., CROAT, T., MAYO, S., HAIGH, A. 2009. **Creating a taxonomic to e-science.** Cate-Araceae. Available at: < http://www.cate-araceae.org/media/df522927-6bfb-1014-a918-dc439151c9e5?view=966728f0-ae51-11dd-ad8b-0800200c9a66>. Accessed: 10 June 2009.

ROMÃO, R., MARTINELLI, G.; CREPALDI, I.; MARTINEZ-LABORDE, J.B. Brazilian biodiversity for ornamental use and conservation. **Crop Breeding and Applied Biotechnology**, v.15, n.2, p.100-105, 2015.

SILVA, J.A.T.; DOBRÁNSZKI, J.; WINARTO, B.; ZENG, S. *Anthurium* in vitro: A review. **Scientia Horticulturae**, v.186, p.266-298, 2015.

STUMPF, E.R.T.; HEIDEN, G.; BARBIERI, R.L.; FISCHER, S.Z.; NEITZKE, R.S.; ZANCHET, B.; GROLLI, P.R. Método para avaliação da potencialidade ornamental de flores e folhagens de corte nativas e não convencionais. **Revista Brasileira de Horticultura Ornamental**, v.13, p.143-148, 2007.

STUMPF, E.R.T.; SILVA, P.S; ROMAGNOLI, I.D.; FISCHER, S.Z.; MARIOT, M.P. Espécies nativas que podem substituir as exóticas no paisagismo. **Revista Brasileira de Horticultura Ornamental**, v.21, p.165-172, 2015.

TOMBOLATO, A.F.C. Potencial ornamental de espécies nativas. **Revista Brasileira de Horticultura Ornamental**, v.14, n.1, p.27-28, 2008.