

## Characterization and selection of torch ginger for cut flower<sup>(1)</sup>

PAULA GUIMARÃES PINHEIRO DE ARAÚJO<sup>(2)</sup>, JOÃO CARLOS CÉSAR DE ALBUQUERQUE FILHO<sup>(3)</sup>,  
SIMONE SANTOS LIRA SILVA<sup>(3)</sup>, CARLOS EDUARDO FERREIRA DE CASTRO<sup>(4)</sup>,  
CHARLESTON GONÇALVES<sup>(4)</sup>, VIVIAN LOGES<sup>(3)\*</sup>

### ABSTRACT

Torch ginger, *Etilingera elatior*, is among the most cultivated tropical flower of its genus. Its great acceptability in the market led researchers to improve production characteristics and to adapt it for commercialization. This study aimed to characterize 10 genotypes of torch ginger in order to select and recommend them as cut flower. The experiment ran from Jan 2014 to Dec 2016 in Paulista, Brazil and nine agro-morphological characteristics were evaluated to build a grading system that determined their suitability for cut flower. The IAC 26 and IAC 34 genotypes were classified as poorly suitable, for they presented fresh mass exceeding 237 g. They also presented less than 19 flower stems per clump and only one month with  $\geq 1$  floral stem produced in 2015. The genotypes IAC 1, IAC 2, IAC 3, IAC 11, IAC 13 and the cultivar IAC Prumirim were classified as suitable, although they obtained intermediate scores for most of the evaluated criteria. The genotype IAC 41 and the cultivar IAC Camburi were classified as very suitable for cut flower, beginning of flowering period at 12 months, produce 33.25 and 41.20 flower stem per clump, respectively, and present seven months with production of more than one floral stem per clump in 2016, achieving maximum scores from most of the evaluated characteristics.

**Keywords:** *Etilingera elatior*, tropical flowers, production.

### RESUMO

#### Caracterização e seleção de bastão-do-imperador para flor de corte

Bastão-do-imperador, *Etilingera elatior*, é a espécie mais cultivada de flores tropicais do gênero. A sua aceitabilidade no mercado levou os pesquisadores a melhorarem características de produção e adequá-las para a comercialização. Esta pesquisa tem por objetivo caracterizar 10 genótipos de bastão do imperador para seleção e recomendação como flor de corte. O experimento foi conduzido de janeiro de 2014 a dezembro de 2016 em Paulista, Brasil. Foram avaliados nove características morfoagronômicas para classificar e determinar a adequação para a flor de corte. IAC 26 e IAC 34 foram classificados como pouco adequados, com massa fresca superior 237 g, número de hastes florais inferior a 19 por touceira e apenas um mês com produção de uma ou mais hastes florais em 2015. Os genótipos IAC 1, IAC 2, IAC 3, IAC 11, IAC 13 e a cultivar IAC Prumirim foram classificados como adequados, embora tenham obtido pontuação intermediária para a maioria dos critérios avaliados. Os genótipos IAC 41 e a cultivar IAC Camburi foram classificados como muito adequados para flor de corte, iniciando o período de florescimento aos 12 meses, produzindo 33,25 a 41,20 hastes florais por touceiras, respectivamente, e apresentaram sete meses com produção de mais de uma hastes floral por touceira em 2016, alcançando máxima pontuação para a maioria dos caracteres avaliados.

**Palavras-chave:** *Etilingera elatior*, flores tropicais e produção.

### 1. INTRODUCTION

The increasing consumer demand for versatility, durability and low cost of flowers in the last few years, has made markets constantly seek out for new products. Thereby, new varieties are constantly introduced into the flower market every year, contributing to its renewal.

Several steps are required to obtain and recommend improved genotypes. The conservation, characterization, evaluation and records of germplasm banks are essential steps that may not be underestimated (NASS and PATERNIANI, 2000). Those are essential stages for

germplasm classification and utilization, as they allow the identification of promising cultivars that either can integrate breeding programs or be validated by farmers for cultivation.

Among the tropical flowers, *Etilingera elatior* (Jack) R. M. Smith is the most cultivated species of the genus *Etilingera*, and popularly known as torch ginger. It is an herbaceous, perennial, and rhizomatous plant that belongs to the Zingiberaceae family. The clumps are vigorous, with the emission of vegetative and floral stems in the periphery and in the center of the clump. The inflorescences show colors that vary from red and pink to white, which grow

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<sup>(2)</sup>Instituto Federal de Pernambuco, Campus Vitória de Santo Antão/IFPE, Vitória de Santo Antão-PE, Brazil.

<sup>(3)</sup>Universidade Federal Rural de Pernambuco (UFRPE), Recife-PE, Brazil. \*Corresponding author: [vloges@yahoo.com](mailto:vloges@yahoo.com)

<sup>(4)</sup>Instituto Agronômico (IAC), Centro de Horticultura, Campinas-SP, Brazil.

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directly from the rhizomes (LOGES et al., 2008b). It is a species used for many purposes such as culinary, medicinal, essential oil extract, and ornamental (CHAN et al., 2011; CHOON and DING, 2016).

In Brazil, Pernambuco state in the Northeast region stands out for the cultivation of white, red, and pink torch ginger to be used as cut flower (LOGES et al., 2008b). However, inadequate characteristics, i.e. low productivity, seasonality, large and heavy flower stems, and low durability were observed in some genotypes, deeming necessary to conduct further screening for suitable species and cultivars to the market.

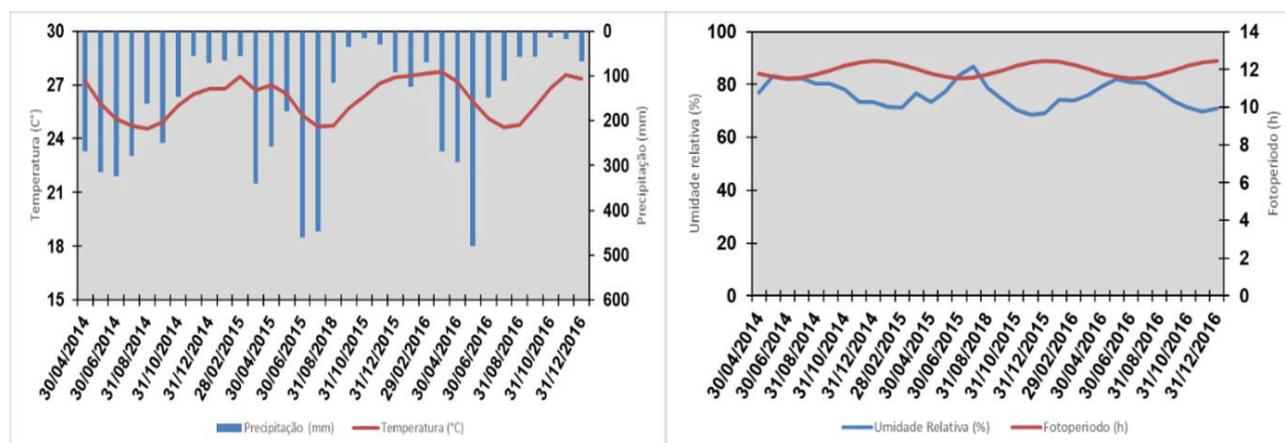
Hoult and Marcsik (2000) in Australia evaluated four cultivars of torch ginger that produced from 50 to 200 flower stems per clump, with post-harvest durability ranging from 3 to 10 days. Gonçalves et al. (2014) performed the agromorphological and molecular characterization of 75 half-siblings of torch ginger from the germplasm collection of the Agronomic Institute (IAC, Brazil), and observe a high genetic diversity. In 2015, the cultivars IAC Prumirim, IAC Itamambuca, IAC Camburi, and IAC Cacheffo (*E. elatior* x *E. haemespherica*) were introduced to the Brazilian flower

market. These cultivars have post-harvest durability, shape and weight that allow greater efficiency during transport and commercialization (GONÇALVES et al., 2015).

It is important to analyze the environmental adaptability and market fit of genotypes or new cultivars by regional field testing. This study aimed to characterize ten torch ginger genotypes and to select the most suitable for cultivation as cut flower.

## 2. MATERIAL AND METHODS

The experiment was carried out between January 2014 and December 2016 in Paulista, in the so-called Zona da Mata of Pernambuco State, Brazil (located at 08°01'19" South, 34°59'33" West, at 100 a.s.l.). The region presents a tropical climate (Am') according to the classification of Köppen's (ALVARES et al., 2013). The monthly temperature, precipitation, and relative humidity data were obtained from the National Institute of Meteorology (Figure 1). The photoperiod or effective period was the number of hours of sun exposure of the experimental area during the 24-hour period (VAREJÃO-SILVA, 2006).



**Figure 1.** Precipitation, temperature, relative humidity, and photoperiod from January 2014 to December 2016.

Ten half-siblings genotypes of torch ginger (Figure 2) originated from a random cross-section from the Germplasm Collection of the Agronomic Institute, were evaluated. In January 2014, rhizomes bearing 20 cm of pseudostem of eight pre-selected genotypes IAC 1, IAC 2,

IAC 3, IAC 11, IAC 13, IAC 26, IAC 34, and IAC 41) and two cultivars (IAC Prumirim and IAC Camburi) registered in SNP-C-MAPA-Brazil, were cleaned, submitted to the regular disease and pests control treatment, and planted in beds for rooting.

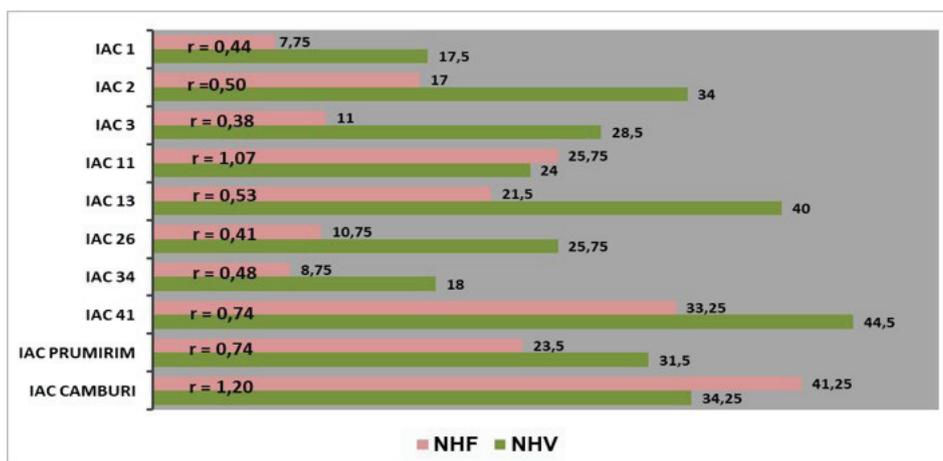


Figure 2. Genotypes of the *Etilingera elatior*, cultivated in half-shade.

In April 2014, four clumps (the rhizome with roots and new shoots) were transplanted in randomized blocks to the experimental area, spaced by 1.5 x 1.5 m. The area was partially shaded by trees, with a high sprinkler irrigation system used in alternate days, except on rainy days. Local agricultural practices were adopted and the clump was fertilized with NPK (200 g) and organic compost (1 Kg) each three months.

As like in May 2014, the clumps were periodically evaluated for the following characteristics: BF - beginning of flowering; NFS - number of floral stems per month in the clump; and NVS - number of vegetative stems per month. The vegetative stems, that present conical shape with the upper part pointed, and the floral stems, that was more cylindrical shape, were marked at 8 cm. The ratio (r) between the NVS and the NFS emitted three months later, period necessary for the emission of the floral stem after the emission of the vegetative stem was calculated. All inflorescence flower stems were harvested closed (base bracts closed), semi-open (base bracts beginning to open and central part of the inflorescence visible) or open (base bracts completely open and flower opening). From the data collected, the development period from the emission of the floral stem to the harvest (CYCLE) was obtained.

The flower stems were evaluated for: IW - inflorescence width, measured in the largest part of the inflorescence; IL - inflorescence length, from the base of the inflorescence to its apex; SL - floral stem length, distance from the base

of the pseudostem to the inflorescence apex; SD - floral stem diameter, measured 20 cm below the inflorescence; FM - fresh mass with the floral stem length standardized at 80 cm; and PHD - postharvest durability of semi-open inflorescences. For the evaluation of PHD, the floral stems were placed in containers with tap water and evaluated every two days. They were discarded when signs of senescence, such as darkened and dried edges of the bracts, were observed. The storage conditions were constant at 25 °C with relative humidity approx. 77%.

Following the score to the agro-morphological characteristics (Table 1), the genotypes were classified for cut flower use as: Very suitable - score  $\geq 27$ ; Suitable - score between 22 to 26; Poorly suitable - score  $\leq 21$ .

For the analysis of the NFS data, the plot was subdivided in time (plot being the genotype and the time as subplot). The NFS data was grouped by semester starting in January 2015, beginning of the flowering period: 1<sup>st</sup> semester - from 13 to 18 months after planting (MAP); 2<sup>nd</sup> semester - from 19 to 24 MAP; 3<sup>rd</sup> semester - from 24 to 30 MAP; and 4<sup>th</sup> semester - from 31 to 36 MAP. The Scott-Knott clustering and Tukey tests were used, both at 5% probability, using the Sisvar software version 5.7 (Build 77). For the variables LI, WI, LS, DS, MF, CYCLE, and PHD, the 4<sup>th</sup> semester data were used with the randomized block scheme using Tukey test, 5% probability, with the Genes program VS 2013.5.1 (CRUZ, 2013).

**Table 1.** Score to agro-morphological characteristics of *E. elatior* for cut flower use (adapted from GONÇALVES et al., 2014).

Characteristics	Score		
	1	2	3
IL	-	≤ 11 ou ≥ 16	12 a 15
IW	-	≤ 13 ou ≥ 18	14 a 17
SL	-	≤ 99 ou ≥ 129	100 a 128
SD	-	≤ 0.90 ou ≥ 1.66	1.00 a 1.65
FM	-	≥ 237	166 a 236
CYCLE	≥ 60	41 a 59	≤ 40
PHD	≤ 3	4 a 6	≥ 7
BF	≥ 19	13 a 18	≤ 12
NFS	≤ 19	20 a 29	≥ 30
MP for 2015 and 2016	≤ 3	4 a 6	≥ 7

IL – inflorescence length (cm); IW – inflorescence width (cm); SL - floral stem length (cm); SD - floral stem diameter (cm); FM - fresh mass (g); CYCLE - development period from the emission of the floral stem to the harvest (days); PHD - post-harvest durability (days); BF - beginning of the flowering (months); NFS - number of floral stems e MP for 2015 and 2016 – (months with production ≥ 1 floral stem, per year).

### 3. RESULTS AND DISCUSSION

The experiment highlighted differences between the evaluated genotypes. The agromorphological characteristics led to understand the development of the torch ginger in the period of three years, being possible thus, to select two genotypes for cut flower use in the Zona da Mata of Pernambuco State, Brazil.

The genotypes IAC 1, IAC 3, IAC 11, IAC 13, IAC 26, IAC 41, and the cultivars IAC Prumirim and IAC Camburi stood out with the beginning of the flowering (BF) at 12 months after planting (MAP) (Figure 3). Only IAC 2 and IAC 34 showed BF at thirteen and fourteen MAP, respectively. According to Ribeiro et al. (2012), the torch ginger flowering begins from 12 to 18 MAP. Early flowering genotypes are more indicated, as they provide faster production and harvest, as well as earlier return to the production investments.

It was possible to observe the absence of production in some genotypes in several months of the year. However, there was no evidence of seasonality or influence of the temperature, precipitation, and photoperiod on the yield, once there was no concentration of production in a periodically manner. According to Nascimento et al. (2015), shading in the base of the plant may reduce the

development of the floral stem, but those that develop are high quality stems.

The genotypes IAC 1 and IAC 3 presented less than one floral stem in all months of 2015 (Figure 3). The number of flower stems (NFS) per clump was higher in the IAC 41 and IAC Camburi, with more than three flower stems in several months of the year (Figure 3). The genotypes IAC 2, IAC 11, IAC 13, IAC 41, and IAC Camburi showed a peak of NFS between November and December 2016. Loges et al. (2008a) observed at the same location that torch ginger red and light pink showed peak of production from September to November 2005. Producers prefer genotypes with high monthly production throughout the year, since demand is equally distributed throughout the year.

Only the cultivar IAC 41 showed a significant difference for NFS over time, with higher production (17.25 NFS) in the fourth semester (Table 2). The genotypes IAC 1, IAC 2, IAC 11, and the cultivars IAC Prumirim and IAC Camburi showed higher production in the second (2.00, 5.50, 9.75, 6.00 and 13.00) and fourth semester (3.00, 6, 75, 5.75, 10.00 and 12.75). The genotypes IAC 3, IAC 13, and IAC 26 increased production over time. The genotype IAC 34 alone reduced the production in the fourth semester (1.50 NFS), but there was no statistical difference between the genotypes.



**Figure 3.** Number of vegetative stems (NVS - green column) and number of floral stems (NFS - pink column) per clump of genotypes *Etlingera elatior* from May 2014 to December 2016.

**Table 2.** Number of floral stems (NFS) per semester in torch ginger genotypes (*Etilingera elatior*), from January 2015 to December 2016, Paulista-PE.

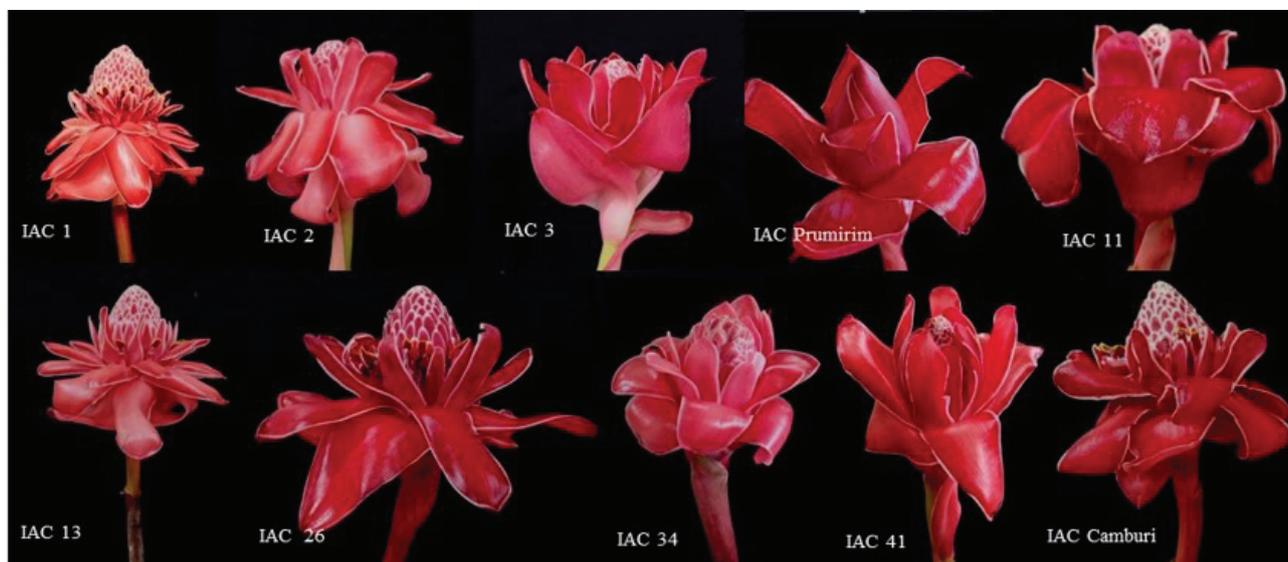
Genotypes	IL(cm)	IW(cm)	SL(cm)	SD(cm)	FM(g)	CYCLE (day)	PHD(day)
IAC 1	7.22a	7.31b	79.39a	1.08a	171.14a	52.37a	5.00a
IAC 2	10.82a	13.86ab	118.30a	1.21a	195.36a	66.17a	6.45a
IAC 3	9.36a	10.97ab	100.28a	0.87a	147.69a	52.28a	5.29a
IAC 11	7.51a	9.47ab	87.41a	1.05a	140.48a	69.49a	6.10a
IAC 13	9.59a	12.17ab	128.49a	1.21a	165.25a	70.97a	7.90a
IAC 26	11.18a	14.20ab	150.59a	1.39a	248.85a	68.59a	6.71a
IAC 34	8.89a	11.59ab	116.22a	1.35a	277.03a	59.52a	5.93a
IAC 41	12.57a	15.93a	134.59a	1.43a	273.75a	61.16a	8.09a
IAC Prumirim	10.23a	11.89ab	95.79a	1.03a	144.35a	70.34a	4.89a
IAC Camburi	9.48a	11.42ab	114.23a	1.19a	179.09a	63.78a	5.86a

\* Averages followed by the same letter in the column, do not differ from each other, by the Tukey test at the level of 5%

IL – inflorescence length; IW – inflorescence width; SL - floral stem length; SD - floral stem diameter; FM - fresh mass; CYCLE - development period from the emission of the floral stem to the harvest e PHD - post-harvest durability.

The IAC 41 and IAC Camburi flower stem productions stood out ahead of the others during the evaluated period, with 33.25 and 41.25 NFS, respectively (Figure 4). Loges et al. (2008a), evaluating the production of a red and light pink torch ginger in a five years old clump, observed 109.66 and 68.00 flower stems per year, respectively, values above those observed in this experiment. It can be

related to the clump age, once after the planting, the clumps pass through a period of development and establishment of the production (LOGES et al., 2008b). Ribeiro et al. (2012) assures that a torch ginger clump produces around 50 floral stems per year after the establishment. Hoult and Marcsik (2000) in Australia observed from 50 to 200 floral stems in four cultivars of torch ginger.



**Figure 4.** Ratio between the number of vegetative stems (NVS) and the number of floral stems (NFS) per clump, from May 2014 to December 2016, Paulista-PE.

According to Choon and Ding (2016), the growth of the torch ginger plant is divided into a vegetative phase, with the growth of the vegetative stem, and a reproductive phase, when the flower stem emerges from the rhizome. In the reproductive phase was observed the remobilization of photo-assimilates from the vegetative stem to develop the flower stem. It caused the vegetative

stem to senesce from the basal part towards the apex and its tipping later. The authors affirm that in torch ginger plants one vegetative stem produces only one floral stem and the mechanisms that regulate the production of flower stems in torch ginger clumps have not been studied yet. In this experiment was observed higher NFS than vegetative stems (NVS) only in IAC Camburi

and IAC 11, with ratio ( $r$ ) of 1.2 and 1.07, respectively (Figure 4). The other genotypes showed higher NVS than NFS. IAC 3 presented the lowest ratio ( $r = 0.38$ ), followed by IAC 1, IAC 26, and IAC 34 ( $r = 0.44$ , 0.41 and 0.48, respectively), indicating that further researches are needed to improve these ratios and to study the aspects that regulate flowering and senescence in torch ginger plants, as well.

Among the flower stem characteristics evaluated, only the inflorescence width (IW) showed a significant difference among the genotypes. The IAC 41 presented the largest IW with 15.93 cm, while the IAC 1 presented the lowest with 7.31 cm (Table 3). Inflorescence length (IL) ranged from 12.57 (IAC 41) to 7.22 (IAC 1). Those

characteristics are directly related to packaging and transportation processes. Very long and wide inflorescences are not appreciated as it may present friction between the bracts and impacts from the carton, causing mechanical damage and depreciation. Besides, it also reduces the amount (units / box) to be transported. Gonçalves et al. (2015) indicated that torch ginger ideal genotypes for cut flower should have inflorescence length between 12 to 14 cm and inflorescence width between 14 to 17 cm. Nevertheless, the length and width of torch ginger inflorescence is associated with the maturation sequential development (CHOON and DING, 2016), and the market accepts different opening points (closed, semi-open or open) depending on the floral design and durability required.

**Table 3.** Characteristics of the flower stems of torch ginger (*Etilingera elatior*) genotypes evaluated from July 2016 to December 2016.

Genotypes	1 <sup>st</sup> Sem.	2 <sup>nd</sup> Sem.	3 <sup>rd</sup> Sem.	4 <sup>th</sup> Sem.
	13 a 18 MAP	19 A 24 MAP	25 A 30 MAP	31 a 36 MAP
IAC 1	1.00Aa	2.00Aa	1.75Aa	3.00Aa
IAC 2	1.75Aa	5.50Aa	3.25Aa	6.75Aa
IAC 3	0.25Aa	1.50Aa	3.00Aa	6.25Aa
IAC 11	4.70Aa	9.75Aa	5.25Aa	5.75Aa
IAC 13	2.50Aa	3.75Aa	5.5Aa	9.75Aa
IAC 26	0.25Aa	1.75Aa	1.75Aa	7.00Aa
IAC 34	0.75Aa	2.75Aa	4.00Aa	1.50Aa
IAC 41	1.50Ba	7.00ABa	7.5ABa	17.25Aa
IAC Prumirim	2.00Aa	6.00Aa	5.20Aa	10.00Aa
IAC Camburi	6.00Aa	13.00Aa	9.25Aa	12.75Aa

\* Averages followed by the same horizontal capital letters do not differ from each other, (Tukey test)

\*\* Averages followed by the same lowercase and vertical letters do not differ statistically from each other, (Scott-Nott's test) IL - comprimento da inflorescência (cm); IW - largura da inflorescência (cm); SL - comprimento da haste floral (cm); SD - diâmetro da haste floral (cm); FM - massa fresca (g); CICLE - período de desenvolvimento da emissão da haste floral até a colheita (dias); PHD - durabilidade pós-colheita (dias); AM - início da floração (meses); NFS - número de hastas florais e MP para 2015 e 2016 - (meses com produção  $\geq 1$  haste floral, por ano).

Regarding to the floral stem length (SL), it should be approximately 80 cm for a better use by the florists, allowing them to make compact or taller arrangements, and this length was observed in all genotypes. Gonçalves et al. (2014), indicated ideal genotypes for cut flower should have SL between 100 to 128 cm. The genotypes IAC 2, IAC 3, IAC 34, and IAC Camburi presented averages within that range (118.30; 100.28; 116.22 and 114.23 cm, respectively). Loges et al. (2008a) and Choon and Ding (2016) observed that after the development of the inflorescence bud, there is no elongation of the floral stem and, if it does not have a commercial length, it may be removed from the clumps and discarded.

The IAC 3 was the only genotype that presented stem diameter (SD) smaller than 1 cm (0.87 cm). In order to bear the inflorescence and prevent stem tipping, Loges et al. (2005) recommends a floral stem diameter of 1.00 cm; and Gonçalves et al. (2014) between 1.30 and 1.65 cm.

Nevertheless, it is not interesting to have very large stem diameters, once it is directly related to the final weight of the floral stem.

The fresh mass (FM) of the flower stem were between 140 and 277 for all genotypes. According to Gonçalves et al. (2014) despite, the great acceptability of torch ginger by the consumers, its commercialization is restricted due to the high weight of the flower stem. It may difficult harvesting, packing, and transportation processes, indicating FM between 166 to 236 g. The genotypes IAC 1, IAC 2, and cultivar IAC Camburi showed the suggested range, but lighter floral stems should be selected.

The CYCLE, period between the floral stem emission until the harvest, ranged from 52 to 70 days. Gonçalves et al. (2014) observed genotypes with CYCLE ranging from 32 to 50 days. This characteristic is interesting to the producer, once it makes possible plan the forthcoming production, aiding in their sales.

The postharvest durability (PHD) observed in IAC 41 was 8 days, followed by IAC 2, IAC 11, IAC 13 and IAC 26 that were 7 and 6 days, and less than 5 days in the other genotypes, including IAC Prumirim and IAC Camburi. Castro et al. (2013) observed PHD of 8 days for those cultivars. According to the literature the post-harvest durability varies widely. Hoult and Marcsik (2000) in Australia observed postharvest durability of 3 up to 10 days to four torch ginger cultivars and Choon and Ding (2013) observed 6 days.

Carneiro et al. (2014) concluded that the postharvest durability was correlated to the harvest point: only 4 days for the floral stems with open inflorescences and 10 days for floral stems with semi-open inflorescences. According to Choon and Ding (2017), when the true flowers of the torch ginger inflorescences start to open sequentially, the external bracts and the upper part of the peduncle begin to darken and dry, due to the reduction of soluble sugars and the degradation of the starch grains accumulated by the plant and used during the formation of the flowers. Thus, to

guarantee the quality and durability of the flower stems, the inflorescences must be harvested before the flowers open, at the close or semi-open harvest points.

The PHD directly sets conditions for marketing flower stems. Floral stems with PHD longer than 10 days may be sent to distant locations and used longer-lasting events. However, floral stems with PHD shorter than eight days are restricted to sales in local markets and short-term events such as parties, a fact observed in the Recife-PE market.

Based on the score system proposed to select torch ginger genotypes as cut flowers (Table 4), it was observed that: IAC 26 and IAC 34 were classified as poorly adapted, presenting higher FM (237 g), NFS less than 19 and less than three months emitting floral stems in 2015 and 2016. IAC 1, IAC 2, IAC 3, IAC 11, AC 13 and IAC Prumirim received intermediate scores for most of the evaluated criteria and so were classified as adequate; IAC 41 and IAC Camburi, received maximum scores for most of the evaluated characteristics and so were classified as very suitable.

**Table 4.** Classification to suitability for using as cutting blossom of torch ginger genotypes (*Etilingera elatior*) from January 2015 to December 2016

Genotypes	IL	IW	SL	SD	FM	CYCLE	PHD	BF	NFS	MP (15)	MP (16)	Total	Use as Cut flower
IAC 1	2	2	2	3	3	2	2	3	1	1	1	22	Suitable
IAC 2	2	2	3	3	3	1	2	2	1	1	2	22	Suitable
IAC 3	2	2	3	2	3	2	2	3	1	1	2	23	Suitable
IAC 11	2	2	2	3	3	1	2	3	2	3	2	25	Suitable
IAC 13	2	2	2	3	3	1	3	3	2	1	3	25	Suitable
IAC 26	2	3	2	3	1	1	2	3	1	1	2	21	Poorly suitable
IAC 34	2	2	3	3	1	2	2	2	1	1	1	20	Poorly suitable
IAC 41	3	3	2	3	1	1	3	3	3	2	3	27	Very suitable
IAC Prumirim	2	2	2	3	3	1	2	3	2	2	3	25	Suitable
IAC Camburi	2	2	3	3	3	1	2	3	3	3	3	28	Very suitable

IL – inflorescence length; IW – inflorescence width; SL - floral stem length; SD - floral stem diameter; FM - fresh mass; CYCLE - development period from the emission of the floral stem to the harvest e PHD - post-harvest durability; BF - beginning of flowering; NFS - number of floral stems (2015 e 2016) and MP for 2015 and 2016 – (months with production ≥ 1 floral stem, in the year).

#### 4. CONCLUSIONS

It was possible to characterize torch ginger genotypes leading to the recommendation of IAC 41 and the IAC Camburi suitable for cut flower production in Zona da Mata of Pernambuco State, Brazil, area of the study.

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#### AUTHORS CONTRIBUTIONS

**P.G.P.A.** : Planting of genotypes; character propose; evaluation of genotypes in the field; results discussion and scientific writing. **J.C.C.A.F.** : Planting of genotypes; evaluation of genotypes in the field; and results discussion. **S.S.L.S.** : Planting of genotypes; evaluation of genotypes in the field; and results discussion. **C.E.F.C.** : Results discussion and scientific

writing. C.G. <sup>ORCID</sup>0000-0001-5414-0306. Results discussion and scientific writing. V.L. <sup>ORCID</sup>0000-0001-9948-9501: Planting of genotypes; character propose; evaluation of genotypes in the field; results discussion and scientific writing.

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