The Florida Series of Hybrid Amaryllis: Five New *Hippeastrum* Cultivars

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Hippeastrum Herbert, amaryllis, has yielded popular large-flowered hybrids over a 200-year breeding history with The Netherlands and South Africa currently dominating the market (Meerow, 2009). The U.S. Department of Agriculture breeding program, with goals of developing cultivars with heat resistance and novel floral phenotypes, has been ongoing for nearly 15 years. In this article, we announce the release and availability for license of five hybrid cultivars as the Florida series of hybrid amaryllis.

Hippeastrum ‘Boca’^{PPAF}, ‘Jax’^{PPAF}, ‘Miami’^{PPAF}, ‘Orlando’^{PPAF}, and ‘Tampa’^{PPAF} are diploid (‘Jax’, $2n = 22$), triploid (‘Boca’, $2n = 33$), or tetraploid and tetraploid-derived aneuploid (‘Miami’, ‘Orlando’, ‘Tampa’; $2n = 43, 44$) hybrids (Figs. 1–3). Each cultivar is suitable for forcing as flowering plants and responds successfully to the protocols summarized by Okubo (1993). The cultivars exhibit novel floral coloration patterns and resistance to red scorch [*Stagonospora curtisii* (Berk.) Sacc.].

Origin

These cultivars originated from a breeding program initiated in 1999 (Meerow, 2009), which began with a primary F_1 hybrid between *H. ambiguum* Herb. ex Hook. and *H. papilio* (Rav.) Van Scheepen (Table 1). Secondary F_1 interspecific crosses used in the breeding program were *H. ambiguum* × *H. brasilianum* and *H. lapacense* (Card.) Van Scheepen × *H. papilio* (Table 1). All species germplasm are in the author’s living research collection and were received originally from the late Fred Meyer and David Bell. Diploids were then crossed with older, commercial tetraploid cultivars in hopes of obtaining triploid or tetraploid progeny exhibiting the *gigas* effects of polyploidy (Bell, 1973a, 1973b, 1977) but retaining some of the unusual floral characteristics of the diploid parents.

Descriptions

Color descriptions are based on evaluations with a Minolta CR-400 colorimeter at

CIE D65/2° illumination/viewer conditions. The color parameters correspond to the uniform color space CIELAB, derived from Gonnet (1993, 1998). Two color coordinates, a^* and b^* , as well as a psychometric index of lightness, L^* , are defined. The L^* is a measurement of luminosity, i.e., the equivalence of each color on the gray scale ranging from 0 (black) to 100 (white). The a^* takes positive values (0 to +60) for reddish colors and negative values (0 to –60) for the greenish ones, whereas the b^* takes positive values (0 to +60) for yellowish colors and negative values (0 to –60) for the bluish ones. This is a much more precise and repeatable analysis of color than obtained by using color charts (Ayala-Silva et al., 2005; Ayala-Silva and Meerow, 2006; Meerow and Ayala-Silva, 2008). The colorimeter takes three consecutive measurements of each sample, which was repeated three times; thus, each set of color coordinates obtained are means of nine measurements. Where a reasonably close match could be discerned, the Royal Horticultural Society Color Chart (RHS; Royal Horticultural Society, 1995) is also referenced.

Ploidy of the cultivars was determined from leaf tissue samples with a Partec CyFlow Ploidy analyzer (Partec GmbH, Münster, Germany) using the Precise P protocol according to the manufacturer’s directions. Ten samples were assayed for each cultivar. The traces were visualized using the program WinMDI Version 2.8 (Trotter, 2004). Mitotic metaphase chromosomes of three cultivars were prepared from root tips collected in deionized water, treated for 1.5 h with nitrous oxide, fixed in glacial acetic acid for 3 h, then stored in 70% EtOH until staining with 4’,6-diamidino-2-phenylindole.

‘Boca’. ‘Boca’ (Figs. 1A–B and 2A–B) originated as a cross made by the inventor in

2001 as part of a breeding program in Miami, FL (Table 1). First flowering was in Spring 2004 at 3 years of age. Bulbs are 5 to 6 cm in diameter (18 to 19 cm circumference) at first flowering, maturing to 8 to 9 cm (≈ 28 cm circumference), producing one to two offset bulbs annually. Leaves are lorate with obtuse apices and entire margins, four to six per bulb, increasing to 10 to 12 late in the season, 44 to 71 cm long, and 3.5 to 5.5 cm wide. Coloration of the upper surface of the young foliage is RHS yellow–green 144A and the lower surface is RHS yellow–green 144B. The upper surface of the mature foliage is colored $L^*(C) = 42.72$, $a^*(C) = -15.77$, $b^*(C) = 23.89$; the lower surface is $L^*(C) = 49.99$, $a^*(C) = -16.03$, $b^*(C) = 26.77$. Scapes are 44 to 56 cm tall, hollow, ≈ 1.5 cm in diameter, two to three per bulb, each bearing four (rarely three) flowers per scape; pedicels are 2 to 3 cm long. The perianth has a slight “butterfly”-like shape (most likely the influence of *H. papilio*) and is 13 to 14 cm long, 14 to 15 cm wide laterally, 16 to 18 cm dorsal-ventrally. The six tepals are of medium texture. Outer tepals are broadly ovate, 12.5 to 13 cm long, and 7 to 7.5 cm wide at their broadest, densely striated RHS red–purple 57A, especially the upper, with darker markings at the throat (Table 2), and faint RHS white 155D keels; margins are irregularly RHS white 155D. Tepal outer surfaces are more lightly striated with infusions of RHS yellow–green 149B and RHS grayed red 178B along the keels. The inner tepals are ovate, the ventral tepal narrower than the laterals, 12 to 12.5 cm long, and the inner laterals 6 to 7 cm wide; the ventral inner is ≈ 5 cm wide. They are colored as per the outer whorl but dark markings at the throat more pronounced on the laterals and have irregular RHS white 155D margins. The throat is green with a short paraperigone of laciniate fimbriae. The six stamens are 10 to 11.2 cm long, concolorous with the perianth for most of their length, and RHS yellow–green 149B in the proximal 1.5 cm; anthers are elliptic, ≈ 7 mm long, RHS white 155D; pollen is RHS yellow 8C. The style is 13 to 14 cm and colored similarly to the staminal filaments for most of its length, RHS yellow–green 149B in the proximal 2 cm. The trifid stigma is ≈ 7 mm wide, colored RHS white 155D. Ovary shape is ellipsoid, 22 to 34 mm long, 8 to 11.5 mm wide, RHS green 141C; $2n = 33$ (Fig. 4A).

‘Jax’. ‘Jax’ (Figs. 1C–D and 2C–D) originated as a cross made by the inventor in 2001 as part of a breeding program in Miami, FL (Table 1). First flowering was in Spring 2003

Table 1. Pedigrees of *Hippeastrum* ‘Boca’, ‘Jax’, ‘Miami’, ‘Orlando’, and ‘Tampa’.

Cultivar	Maternal parent	Paternal parent
Boca	(AMB × PAP) × (LAP × PAP)	AMB × PAP
Jax	AMB × PAP	BRAS
Miami	‘Mount Blanc’ × [(AMB × PAP) × ‘BOUQUET’]	[(AMB × PAP) × BRAS] × ‘Wonderland’
Orlando	(AMB × PAP) × BRAS	‘Wonderland’
Tampa	(AMB × PAP) × BRAS	‘Wonderland’

AMB = *H. ambiguum*; BRAS = *H. brasilianum*; LAP = *H. lapacense*; PAP = *H. papilio*. Species germplasm used in the breeding originated from the author’s research collections; cultivars were purchased from commercial sources.

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Fig. 1. Pictorial key to flower zones where colorimeter readings were taken on Florida series *Hippeastrum* cultivars. Letters correspond to zones in Table 2. (A–B) *Hippeastrum* ‘Boca’. (A) Adaxial surfaces. (B) Abaxial surfaces. (C–D) *Hippeastrum* ‘Jax’. (C) Adaxial surfaces. (D) Abaxial surfaces. (E–F) *Hippeastrum* ‘Miami’. (E) Adaxial surfaces. (F) Abaxial surfaces. (G–H) *Hippeastrum* ‘Orlando’. (G) Adaxial surfaces. (H) Abaxial surfaces. (I–J) *Hippeastrum* ‘Tampa’. (I) Adaxial surfaces. (J) Abaxial surfaces.

at 2 years of age. Bulbs are 5 to 6 cm in diameter, increasing to 8 to 11 cm with age, producing one to two offset bulbs per year. Leaves are lorate with obtuse apices and entire margins, four to six per bulb (seven to 11 late in the season), 60 to 68 cm long, 3.5 to 4 cm wide at the base, 5 to 6.5 cm at the middle, and 3.5 to 4.5 at 5 cm from the obtuse apex. Young foliage color (upper surface) is RHS yellow–green 144A and the lower surface is RHS yellow–green 144B. Mature foliage upper surface is $L^*(C) = 37.67$, $a^*(C) = -14.45$, $b^*(C) = 19.36$. Mature foliage, lower surface is $L^*(C) = 40.46$, $a^*(C) = -15.16$, $b^*(C) = 21.00$. Scapes are 35 to 45 cm tall, hollow, ≈ 1.5 cm in diameter, two to three per bulb, bearing four to six flowers each; pedicels are 7.5 to 9.5 cm long. Flowers are trumpet-shaped, slightly nodding, 15 to 16 cm long, 12 to 13.5 cm wide laterally, and 14 to 16 cm wide dorsal-ventrally. The six tepals are undulate along their margins, of medium texture, appear luminous and crystalline, the adaxial surface lightly striated amethyst (Table 2; closest to RHS red–purple 73A) on a white background, most prominently on the lateral inner tepals, with a picotee of the same color and a green throat. The reverse (abaxial) surface is more deeply colored along the tepal keels, and the tepals are RHS yellow–green 149A in their lower two-thirds. There is no apparent paraperigone. The lateral outer tepals are 13 to 14.5 cm long, 6 to 6.5 cm wide at their broadest point; the dorsal outer tepals are 12.5 to 14 cm long and 6.3 to 6.8 cm wide; inner lateral tepals are 12.5 to 14 cm long, 5 to 6 cm wide, and the ventral inner tepal is 13 to 14.5 cm long and 4 to 4.7 cm wide. Stamens are 9.5 to 11 cm long, RHS white 155D for most of the length and RHS yellow–green 151B in the proximal 5 cm; anthers are elliptic, ≈ 8 mm long, RHS white 155B; pollen color is RHS yellow 7A. The style is 13.5 to 14 cm long, RHS white 155D for most of length and RHS yellow–green 151B in the proximal 5 cm; the trilobed stigma is ≈ 8 mm wide. The ellipsoid ovary is 22 to 34 mm long, 8 to 11.5 mm wide, RHS green 141C; $2n = 22$ (Fig. 4A).

‘Miami’. ‘Miami’ (Figs. 1E–F and 2E–F) originated as a cross made by the inventor in 2004 as part of a breeding program in Miami, FL (Table 1). First flowering was in Spring 2007 at 3 years of age. Bulbs are 6 to 11 cm in diameter, producing three to five offsets annually. Leaves are lorate with acute apices and entire margins, four to eight per bulb, RHS green 137B, 50 to 65 cm long early in the season, 76 to 82 cm long late in the season, 3.8 to 4 cm wide at the base, 5.5 to 6 cm at midpoint, and 3.5 to 4 cm wide 5 cm from the apex. Young foliage, upper surface is RHS yellow–green 144A and lower surface RHS yellow–green 144B. Mature foliage, upper surface is $L^*(C) = 39.84$, $a^*(C) = -16.02$, $b^*(C) = 23.02$. Mature foliage, lower surface is: $L^*(C) = 46.92$, $a^*(C) = -16.82$, $b^*(C) = 26.76$. Individual bulbs produce two to three scapes annually, 45 to 55 cm tall, 2 to 2.5 cm in diameter at their midpoint, bearing four flowers per scape; pedicels are 4 to 5.5 cm

long. Flowers are broadly funnel-form, 11 to 14 cm long, 14 to 16 cm wide laterally and 16 to 17.5 cm wide dorsal-ventrally composed of six tepals forming a tube in the proximal 2 cm. The broadly ovate lateral outer tepals are 12 to 12.5 cm long, 7.5 to 8.2 cm wide; the dorsal outer tepal is 12 to 12.5 cm long and 8.5 to 9 cm wide. The outer tepals are broadly ovate, 12.0 to 12.5 cm long, 7.5 to 8.2 cm wide, densely striated orange-red (about RHS orange-red 33A) on their adaxial surface (Table 2) with a 1.3- to 1.5-cm wide median RHS white 155D keel; the abaxial surface is reticulated orange-red on a white background, the keel is darker and suffused with RHS yellow-green 144C. The lateral inner tepals are ovate, 11.2 to 12 cm long, and 6.7 to 7 cm wide. The ventral inner tepal is 12 to 12.2 cm long and 5 to 5.5 cm wide. They are colored similarly to the outer whorl, but the dark markings at the throat are more pronounced on laterals. The throat is RHS yellow-green 144B with a paraperigone of laciniate fimbriae. Stamens are 7.8 to 9.4 cm long, speckled RHS orange-red 33A for their distal half, fading to white and finally RHS yellow-green 151B in the proximal one-third to one-fourth; anthers elliptic, ≈ 7 mm long, RHS white 155D; pollen is RHS yellow 3C. The style is 10.5 to 11.7 cm long, diffusely speckled RHS red-orange 33A, fading to RHS white 155D and then RHS yellow-green 151B in its proximal 2 cm; the trilobed stigma is ≈ 6 mm wide, RHS white 155D (RHS orange-red 33A at margins). The ellipsoid ovary is 20 to 23 mm long, 8 to 10 mm wide, and RHS green 141C; $2n = 44$ (Fig. 4A–B).

'Orlando'. 'Orlando' (Figs. 1G–H and 3A–B) originated as a cross made by the inventor in 2001 as part of a breeding program in Miami, FL (Table 1). First flowering was in Spring 2004 at 3 years of age. Bulbs are 6 to 11 cm in diameter (19 to 35 cm circumference), producing three to five offsets annually. Leaves lorate, with acute apices, margins entire, four to six per bulb, up to nine late in the season, 35 to 45 cm long, lengthening to 65 to 72 cm late in the season, 3.5 to 4.0 cm wide at the base, 4.8 to 6.5 cm wide at the midpoint, and 3.7 to 4.3 cm wide at 5 cm from the apex; young foliage colored RHS yellow-green 144A on the upper surface and RHS yellow-green 144B on the lower surface; mature foliage upper surface is: $L^*(C) = 37.57$, $a^*(C) = -13.41$, $b^*(C) = 18.08$, lower surface is: $L^*(C) = 44.34$, $a^*(C) = -15.71$, $b^*(C) = 24.09$. Bulbs produce three to four scapes annually, 40 to 65.7 cm long, ≈ 1 cm in diameter, each bearing four flowers; pedicels are 5.5 to 8.0 cm long. Flowers are broadly funnel-form, 13 to 14.5 cm long, 14 to 16 cm wide laterally, and 17 to 19 cm wide dorsal-ventrally. The tepals are fused into a green tube $L^*(C) = 57.13$, $a^*(C) = -13.95$, $b^*(C) = 32.79$ in the proximal 2 cm. Outer tepals are 12.0 to 12.5 cm long, 7.9 to 9.0 cm wide, broadly ovate, with apiculate apices and entire margins, appearing luminous and crystalline. The upper surface is striated RHS red-purple 66A (Table 2), RHS yellow-green 144C at the base with median

Fig. 2. *Hippeastrum* 'Boca', 'Jax', and 'Miami'. (A–B) *Hippeastrum* 'Boca'. (A) Adaxial surfaces. (B) Abaxial surfaces. (C–D) *Hippeastrum* 'Jax'. (C) Adaxial surfaces. (D) Abaxial surfaces. (E–F) *Hippeastrum* 'Miami'. (E) Adaxial surfaces. (F) Abaxial surfaces.

Fig. 3. *Hippeastrum* 'Orlando' and 'Tampa'. (A–B) *Hippeastrum* 'Orlando'. (A) Adaxial surfaces. (B) Abaxial surfaces. (C–D) *Hippeastrum* 'Tampa'. (C) Adaxial surfaces. (D) Abaxial surfaces.

Table 2. Colorimeter readings under the CIELAB color space for various locations on the flowers of Florida series *Hippeastrum* hybrid.²

Boca					Jax					Miami				
Location (see Fig. 1)		L*(C)	a*(C)	b*(C)	Location (see Fig. 1)		L*(C)	a*(C)	b*(C)	Location (see Fig. 1)		L*(C)	a*(C)	b*(C)
A	Mean	43.42	58.41	20.88	A	Mean	81.97	9.82	2.83	A	Mean	46.82	60.51	55.47
	SD	1.11	2.74	1.67		SD	1.68	0.94	0.18		SD	0.03	0.03	0.08
B	Mean	44.34	52.70	19.12	B	Mean	84.19	11.14	2.60	B	Mean	49.09	55.28	47.16
	SD	0.07	0.04	0.09		SD	3.94	2.99	1.07		SD	1.84	1.71	1.26
C	Mean	48.47	58.35	19.45	C	Mean	78.28	13.69	1.22	C	Mean	48.87	56.43	51.90
	SD	3.40	4.42	0.92		SD	5.20	5.40	1.76		SD	1.19	0.77	1.44
D	Mean	59.64	27.15	9.44	D	Mean	74.56	19.17	−0.39	D	Mean	56.00	50.98	47.28
	SD	0.87	0.82	0.25		SD	0.31	0.05	0.04		SD	0.90	0.37	0.24
E	Mean	47.16	59.76	20.28	E	Mean	81.84	7.52	3.16	E	Mean	59.12	37.75	21.08
	SD	0.52	0.21	0.55		SD	0.48	0.04	0.02		SD	0.22	2.42	0.91
F	Mean	47.92	56.07	15.14	F	Mean	82.55	13.39	1.89	F	Mean	62.51	38.24	23.43
	SD	0.05	0.07	0.08		SD	6.86	6.60	2.56		SD	0.04	0.11	0.16
G	Mean	55.97	50.04	15.83	G	Mean	67.80	26.44	−2.09	G	Mean	57.65	24.99	18.61
	SD	3.35	4.69	1.35		SD	3.90	4.37	2.05		SD	0.14	0.06	0.16
H	Mean	51.49	46.51	14.71	H	Mean	62.74	28.23	1.63	H	Mean	66.20	27.82	17.65
	SD	2.84	11.72	0.69		SD	0.11	0.05	0.02		SD	0.33	0.84	0.42
I	Mean	61.57	32.34	10.86	I	Mean	61.47	31.65	−0.46	I	Mean	52.72	4.08	23.82
	SD	0.05	0.20	0.09		SD	5.67	4.19	1.55		SD	0.44	0.23	0.17
J	Mean	55.29	45.34	12.15	J	Mean	67.22	29.10	15.16	J	Mean	67.22	29.10	15.16
	SD	1.92	5.03	0.98		SD	0.32	0.94	0.39		SD	0.32	0.94	0.39
K	Mean	68.19	9.64	20.27						Lateral inner tepal abaxial (lower keel)	Mean	53.16	24.91	18.84
	SD	0.05	0.05	0.03	SD	0.94	0.87	0.76						
L	Mean	56.49	38.66	12.93						Ventral inner tepal abaxial	Mean	74.28	21.85	13.19
	SD	4.32	11.33	1.59	SD	0.06	0.07	0.05						
M	Mean	58.43	42.01	7.42						Ventral inner tepal abaxial (lower keel)	Mean	68.92	33.07	18.95
	SD	0.06	0.04	0.02	SD	0.06	0.07	0.05						
N	Mean	46.43	30.65	14.05						Ventral inner tepal abaxial (mid keel)	Mean	78.87	19.68	12.22
	SD	0.06	0.09	0.05	SD	0.13	0.08	0.04						
O	Mean	67.38	27.30	9.25										
	SD	3.77	6.77	1.63										
Orlando					Tampa									
Location (see Fig. 1)		L*(C)	a*(C)	b*(C)	Location (see Fig. 1)		L*(C)	a*(C)	b*(C)					
A	Mean	27.1	48.5	22.36	A	Mean	34.81	37.49	12.20					
	SD	0.9	13.1	6.331		SD	0.07	0.22	0.06					
B	Mean	81.54	−0.77	5.79	B	Mean	80.82	−3.21	10.80					
	SD	0.38	0.51	0.16		SD	0.09	0.02	0.04					
C	Mean	83.07	−0.47	6.28	C	Mean	30.49	41.19	14.66					
	SD	0.67	0.19	0.47		SD	0.48	0.84	0.41					
D	Mean	27.78	51.19	22.42	D	Mean	31.25	37.27	13.13					
	SD	0.93	1.09	4.47		SD	1.69	2.19	0.80					
E	Mean	29.38	50.44	21.37	E	Mean	79.88	−0.89	10.23					
	SD	1.43	2.06	3.57		SD	0.10	0.07	0.06					
					F	Mean	31.47	26.77	11.03					
						SD	3.77	6.45	3.29

Fig. 4. Flow cytometric comparison of ploidy in five *Hippeastrum* cultivars and mitotic metaphase chromosome preparations. (A) Composite flow cytometric peaks of five *Hippeastrum* cultivars with *H. papilio* used as standard. (B) $2n = 44$ chromosomes of *Hippeastrum* 'Miami'. (C) $2n = 43$ chromosomes of *Hippeastrum* 'Orlando'. $2n = 43$ chromosomes of *Hippeastrum* 'Tampa'. Scale = 10 μm .

Table 3. Flowering performance of *Hippeastrum* 'Boca', 'Jax', 'Miami', 'Orlando', and 'Tampa' under ambient south Florida conditions over 5 years.^a

Cultivar	Yr	No.	Mean no. scapes per bulb (SD)	Mean no. flowers per scape (SD)
Boca	2009	5	2.5 (± 0.5)	3.4 (± 0.5)
	2010	8	2.7 (± 0.5)	3.6 (± 0.4)
	2011	11	2.2 (± 0.6)	3.7 (± 0.3)
	2012	13	1.9 (± 0.7)	3.7 (± 0.4)
	2013	16	2.8 (± 0.6)	3.8 (± 0.2)
Jax	2009	4	2.7 (± 0.5)	4.2 (± 0.9)
	2010	6	3.1 (± 0.8)	4.1 (± 0.8)
	2011	9	2.3 (± 0.7)	4.3 (± 0.7)
	2012	11	2.1 (± 0.6)	4.3 (± 0.6)
	2013	14	2.9 (± 0.7)	4.2 (± 0.8)
Miami	2009	6	3.0 (± 0.4)	3.6 (± 0.4)
	2010	10	3.1 (± 0.5)	3.3 (± 0.6)
	2011	14	2.6 (± 0.7)	3.4 (± 0.3)
	2012	18	2.4 (± 0.8)	3.4 (± 0.4)
	2013	21	3.1 (± 0.6)	3.6 (± 0.3)
Orlando	2009	8	3.3 (± 0.7)	3.7 (± 0.2)
	2010	12	3.2 (± 0.7)	3.9 (± 0.3)
	2011	15	3.1 (± 0.6)	3.6 (± 0.4)
	2012	18	3.1 (± 0.5)	3.8 (± 0.3)
	2013	24	3.2 (± 0.6)	3.9 (± 0.2)
Tampa	2009	5	2.6 (± 0.65)	4.0 (± 0.3)
	2010	8	3.0 (± 0.8)	3.9 (± 0.2)
	2011	11	2.8 (± 0.6)	4.1 (± 0.1)
	2012	14	2.8 (± 0.6)	3.8 (± 0.3)
	2013	16	2.9 (± 0.5)	4.2 (± 0.2)

^aBulbs were at least 5.0 cm in diameter and at least 4 years old. Bulbs used in these tests were propagated strictly by division.

12.0 to 12.5 cm long, 7.5 to 8.0 cm wide, with an apiculate apex, appearing luminous and crystalline, striated RHS red–purple 60A (Table 2) on their adaxial surface, most intensely on the laterals and most densely

toward the keel, RHS yellow–green 144C at the base, with median RHS white 155D keels 1.3 to 1.5 cm wide and a picotee of RHS red–purple 60A; lower surface striations are more diffuse with a RHS white 155D back-

ground, RHS yellow–green 144C toward the base, keel darker, and suffused with RHS yellow–green 144C near the apex and on either side in the lower half; the throat is RHS yellow–green 144C with a paraperigone of short lacinate fimbriae and a narrow RHS red–purple 59B margin. The lateral inner tepals are 11.0 to 11.5 cm long and 7.4 to 7.8 cm wide; the ventral inner tepal is 11.5 to 12.0 cm long and 6.0 to 6.5 cm wide; both surfaces are colored as per the outer whorl. Stamens are 8.0 to 9.0 cm long, the filaments RHS white 155D in their distal two-thirds, and RHS yellow–green 144C in their proximal one-third; anthers are ellipsoid, ≈ 7 mm long, RHS white 155D; pollen RHS yellow 6C. The style is 11.5 to 12.0 cm long, RHS white 155D for most of its length, green at the base; the trilobed stigma is ≈ 7 mm wide. The ellipsoid ovary is 23.8 to 30.2 mm long, 9.9 to 11.5 mm wide, RHS green 141C; $2n = 43$ ($4n-1$; Figs. 4A and 4D).

Performance

The cultivars have flowered regularly for at least 5 years under ambient south Florida conditions (Table 3). Bulbs are dried in their containers in late October and maintained under 60% shade in pots without irrigation until February. They are then transplanted into fresh substrate and lightly irrigated every 3 to 5 d until scape emergence, after which irrigation was provided every third day. First scapes emerged from the bulbs 1 to 3 weeks after irrigation started. The first flowers opened 3 to 4 weeks after the scapes first emerged. Under these conditions, they are regularly exposed in summer to daytime temperatures greater than 32 °C and night minimums as high as 27 °C.

Bulbs have also flowered when forced according to protocols established by Okubo (1993). Bulbs were placed in darkness at 13 °C and 80% relative humidity (RH) for 8 weeks without irrigation, then grown at 25 °C, 70% RH, with 13 h of light [photosynthetic photon flux (PPF) = 800 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$] and irrigation on alternate days (Table 4). All five cvs. have been experimentally and successfully propagated using twin scale cuttage (Table 5; Traub, 1958) on bulbs ≈ 5.0 cm in diameter. All five cultivars flowered 2.5 years after twin scaling was started.

Cultural Notes

These five cultivars require well-drained organic substrate with a pH of 6.0 to 6.5. In the breeding program, a 5:4:1 mix was used of aged pine bark:coconut coir dust:coarse sand, modified subsequently to 25% total volume with coarse perlite. It was amended with 5.0 $\text{kg}\cdot\text{m}^{-3}$ 17N–2.3P–10K Floricote (Florikan, Sarasota, FL), 4.2 $\text{kg}\cdot\text{m}^{-3}$ dolomite and 1.2 $\text{kg}\cdot\text{m}^{-3}$ Micromax (Scott's, Milpitas, CA). Bulbs were grown in 2.7- to 5.4-L containers, depending on size, on benches under 50% Saran shade (maximum PPF = 1000 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$) and irrigated as needed.

Table 4. Flowering performance of *Hippeastrum* 'Boca', 'Jax', 'Miami', 'Orlando', and 'Tampa' treated according to the forcing protocols of Okubo (1993).²

Cultivar	Yr ²	No.	Mean no. of scapes per bulb (sd)	Mean no. of flowers per scape (sd)	Mean days to emergence of first scape after treatment (sd)	Mean days to anthesis of first scape after treatment (sd)
Boca	2012	4	2.0 (± 0.0)	3.7 (± 0.5)	23.8 (± 2.2)	41.5 (± 1.3)
	2013	8	2.1 (± 0.4)	3.7 (± 0.5)	23.3 (± 1.8)	42.3 (± 1.0)
Jax	2012	4	2.3 (± 0.5)	4.2 (± 0.4)	21.0 (± 1.6)	39.3 (± 1.0)
	2013	8	2.4 (± 0.5)	4.1 (± 0.5)	20.6 (± 1.4)	39.6 (± 1.1)
Miami	2012	4	2.3 (± 0.5)	3.8 (± 0.5)	23.0 (± 1.4)	43.3 (± 0.5)
	2013	8	2.3 (± 0.5)	3.8 (± 0.5)	23.4 (± 1.1)	43.3 (± 1.0)
Orlando	2012	4	2.5 (± 0.6)	3.6 (± 0.6)	19.5 (± 1.3)	40.0 (± 0.8)
	2013	8	2.3 (± 0.5)	3.9 (± 0.5)	20.0 (± 1.3)	40.5 (± 0.9)
Tampa	2012	4	2.3 (± 0.5)	4.0 (± 0.5)	21.5 (± 1.3)	43.0 (± 0.8)
	2013	8	2.4 (± 0.5)	3.9 (± 0.6)	22.0 (± 1.1)	43.4 (± 0.9)

²Forcing pretreatment began 15 Sept. and lasted for 8 weeks, consisting of dark storage in dry medium at 13 °C and 70% relative humidity.

Table 5. Propagation of *Hippeastrum* 'Boca', 'Jax', 'Miami', 'Orlando', and 'Tampa' from twin scale cuttings in 2011.²

Cultivar	Date cuttings taken	No.	Mean no. days until bulblet formation (sd)	Percent scales forming bulblets	Mean no. bulblets per cutting ³ (sd)
Boca	15 Sept. 2011	38	42.7 (± 4.9)	75	1.2 (0.3)
Jax	10 Sept. 2011	43	38.3 (± 3.8)	81	1.1 (0.3)
Miami	15 Oct. 2011	40	47.5 (± 3.4)	72	1.2 (0.2)
Orlando	13 Oct. 2011	36	40.2 (± 5.1)	84	1.3 (0.2)
Tampa	19 Feb. 2011	35	51.6 (± 4.2)	78	1.1 (0.4)

²Bulbs used for cuttage were ≈5.0 cm in diameter.

³Successful cuttings only.

Pest problems have included mealybug (*Pseudococcus* Westwood spp.), scales [Florida wax scale, *Ceroplastes floridensis* Comstock; Magnolia white scale, *Pseudaulacapsis cockerelli* (Cooley)], and *Stethobaris nemesis* Prena and O'Brien, an introduced baridiniid weevil known as amaryllis weevil (Epsky et al., 2008; Prena and O'Brien, 2011), which can be particularly destructive if unchecked. Bulbs in active growth, especially those grown outdoors or in open structures, should be inspected periodically for grasshoppers [(*Romalea guttata* (Latreille)], which can defoliate the plants. To date, these cultivars have not yet exhibited foliar mottling symptomatic of *Hippeastrum* mosaic virus. The cultivars are not highly susceptible to foliar infection by *Staganospora curtisii* (red scorch).

Availability

All five cultivars have patent applications filed with the U.S. Patent Office, and licensing will be handled by the USDA-ARS Office of Technology Transfer (<<http://www.ars.usda.gov/business/docs.htm?docid=763&page=5>>). For technical questions, please contact the author (alan.meerow@ars.usda.gov).

gov). For licensing information, please contact June Blalock, Technology Licensing Program Coordinator (june.blalock@ars.usda.gov).

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