‘Rio’^{PPAF}, ‘Sampa’^{PPAF}, and ‘Bahia’^{PPAF}, Three New Triploid Amaryllis Cultivars

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Additional index words. *Hippeastrum* hybrids, flower bulb, geophyte, ornamentals, floriculture, herbaceous perennial

Hippeastrum Herbert, the amaryllis, has yielded large-flowered, tetraploid hybrids over a 200-year breeding history (Meerow, 1988; Traub, 1934, 1958). Bulbs are produced for indoor forcing (Okubo, 1993) and, to a lesser extent, garden use in mild winter areas (USDA Zones 8 to 11). The initial center of amaryllis breeding was Holland, with the Ludwig strains rapidly becoming the dominant genotypes among Dutch amaryllis (Ludwig and Co., 1948; Meerow, 1988). South Africa has now become an important breeding center and exporter of amaryllis (Barnhoorn, 1976; Buck, 1961; Goedert, 1961). Florida was at one time a substantial producer of hybrid amaryllis bulbs and both Henry Nehrling (Traub, 1934) and Theodore Mead (Bell, 1973a; Hayward, 1934) were breeders there. The Mead hybrids in particular, which originated from Nehrling's germplasm, contributed to modern hybrids when crossed with Ludwig or other Dutch stock (Bell, 1973a). Although the Mead hybrids did not match the Dutch material in flower size and number of scapes produced, they were reliable and vigorous performers under Florida garden conditions (Bell, 1973a). As amaryllis production in Florida declined because of disease, competition, and failures in quality control, much of this germplasm was lost.

The emphasis in commercial breeding efforts has always been on large flower size, attributable specifically to genes originating in *H. leopoldii* (T. Moore) Dombrain and *H. pardinum* (Hook. f.) Lem. (Bell, 1973a; Shields, 1979). Following the initial flurry of primary hybridization, commercial breeding efforts have largely been concentrated among the hybrids themselves, leading to a great complexity of parentage, much without documentation, and dilution of many of the unique characteristics of the original component species (Bell, 1973a, 1973b; Cage, 1978; Meerow, 1988; Shields, 1979).

Received for publication 3 Aug 1998. Accepted for publication 30 Nov. 1998. Florida Agricultural Experiment Station Journal Series No. R-06455. Development of these cultivars was supported in part by the American Floral Endowment. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

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These constraints, whether voluntary or involuntary, on commercial amaryllis breeding have resulted in similarity among many of the modern hybrids. Despite repeated calls for renewed programs of interspecific hybridization (Bell, 1973a, 1977; Buck, 1978; Cage, 1978; Doran, 1982; Shields, 1979), the flowers, while large, tend to be of the wide, flat, “dinner-plate” type with little variation in form or color (Doran, 1982).

Hippeastrum ‘Bahia’^{PPAF}, ‘Rio’^{PPAF}, and ‘Sampa’^{PPAF} are three complex triploid ($2n = 33$) hybrids of *Hippeastrum papilio* (Rav.) Van Scheepen. 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.]. ‘Sampa’ is semi-dwarf and has a floret number higher than that of comparable commercial cultivars.

Origin

These cultivars originated from a breeding program initiated in 1987 (Meerow, 1988; Meerow et al., 1992). The primary species used in the program was *Hippeastrum papilio* (Rav.) Van Scheepen, described by Ravenna (1970), with a number of valuable horticultural qualities: attractive, compact, evergreen foliage; and long-lasting flowers with unusual color range (shades of purple) and zonation. The objectives of the program were to develop unusual diploid phenotypes by crossing *H. papilio* reciprocally with a number of other species. These diploids were then crossed with older, commercial tetraploid varieties in hopes of obtaining triploid progeny exhibiting the *gigas* effects of polyploidy (Bell, 1973a, 1973b, 1977; Shields, 1979), but retaining some of the unusual floral characteristics of the diploid parent. Selected diploid F₁ hybrids of *H. papilio* and *H. ambiguum* Herb. ex Hook. ‘Tweedianum’, *H. lapacense* (Card.) Van Scheepen, and *H. pardinum* were introgressed with the complex Dutch tetraploids ‘Apple Blossom’, ‘Dutch Belle’, and ‘White Christmas’ (Table 1). The tetraploid cultivars can only be used successfully as pollen parents; reciprocal $4n \times 2n$ crosses are not viable. These varieties are the first three releases of the Brazil Cultivar-group of amaryllis hy-

brids; the cultivar names are all place names in Brazil (“Sampa” is the Brazilian diminutive for São Paulo), the home of many *Hippeastrum* species, including *H. papilio*.

Descriptions

Color descriptions below are based on the RHS Colour Chart (Royal Horticultural Society, 1966).

‘Bahia’. ‘Bahia’ (Fig. 1) is moderately tall. Bulbs are 16 to 18 cm in circumference at first flowering, increasing to 26 to 28 cm. Leaves are green (137B), four to six per bulb, 48 to 55 cm long, and 4.5 to 5 cm wide. Scapes are 60 to 65 cm tall, bearing four flowers per scape, and pedicels are 3.5 to 4.5 cm long. The flowers have a luminous, crystalline character due to reflection patterns of the epidermal cells, are 12 cm long, 16.5 cm wide laterally to 18.5 cm wide dorsal-ventrally. The six tepals are slightly undulate along their margins and of medium texture. The outer tepals are 7.2 to 8.8 cm wide at their broadest part; the inner lateral tepals are 5.4 to 6.6 cm wide; the ventral inner tepal is 4.6 to 5.4 cm wide. The flowers are a combination of red (45B) and white, with a red (45B) picotee. The red occurs as dense striations on the dorsal outer tepal and lateral inner tepals with white at the apex. The lateral inner tepals are striated in their upper longitudinal half and white below; the ventral outer tepal is lightly striated in the lower half. The flowers emit a light fragrance. Stamens and style are red (45B).

‘Rio’. ‘Rio’ (Fig. 2) is moderately tall, producing two to three offset bulbs per year. Bulbs are 18 to 20 cm in circumference, increasing to 28 to 30 cm. Leaves are green (137B), four to six per bulb, 25 to 32 cm long and 5 to 7 cm wide. Flowers scapes are 44 to 58 cm tall, bearing four flowers each, and pedicels are 3.5 to 4.5 cm long. Flowers are open funnel-form, sweetly fragrant, first appearing 4 years from seed, and are 15 to 16 cm long, 17 cm wide laterally to 19 cm wide dorsal-ventrally. The six tepals are slightly undulate along their margins, and of medium texture; uniformly a deep pink (52A), and overlain for their entire length by a distinctive median silvery-white stripe that alters the color below to 52C. A small and inconspicuous green (140A) eye occurs at the throat of the flower. The outer tepals (sepals) are 7.3 to 8.7 cm wide at their broadest point; the inner lateral tepals (petals) are 5 to 6 cm, and the ventral inner tepal (petal) is 4.4 to 5.6 cm wide. Stamens and style are deep pink (52A).

‘Sampa’. ‘Sampa’ (Fig. 3) is a semi-dwarf. Bulbs are 17 to 19 cm in circumference, increasing to 27 to 29 cm, producing three to five offsets annually. Leaves are green (137B), four to six per bulb, 45 to 58 cm long, and 5 to 6.5 cm wide. Scapes are 38 to 52 cm tall, bearing five to eight flowers per scape. Pedicels are 5 to 6 cm long. Flowers are broadly funnel-form, slightly fragrant, 13 to 14 cm long, 13 cm wide laterally and 15 cm wide dorsal-ventrally. The six tepals are slightly undulate along their margins, of medium texture, and uniformly 6 to 7 cm wide at their broadest

Fig. 1. *Hippeastrum* 'Bahia'.

Fig. 2. *Hippeastrum* 'Rio'.

Fig. 3. *Hippeastrum* 'Sampa'.

point, with the exception of the ventral inner tepal (4.5 to 5 cm). The three upper tepals are white striated red-purple (57A) with a white median keel; the lower, lateral, outer tepals are white striated in the upper half with red-purple (57A) and a lower white zone; the ventral inner tepal is white striated lightly below and at the margins with red-purple (57A). Stamens and style are white.

Performance

The cultivars flowered regularly for 4 years under ambient south Florida conditions (Table 2). Bulbs are dried in their containers in late October and maintained under 95% shade in pots without irrigation until February. Then they were transplanted into fresh substrate and lightly irrigated every 3 to 5 d until scape emergence, after which irrigation was provided on alternate days. First scapes emerged from the bulbs 1 to 3 weeks after irrigation commenced. The first flowers opened 3 to 3.5 weeks after the scapes first emerged.

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 12 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 3). 'Bahia' can be expected to produce two to three scapes annually; 'Rio' will produce two, rarely three, and 'Sampa' will produce three to four. 'Sampa' consistently displays high bud counts of five to eight flowers per scape, whereas 'Bahia' and 'Rio' produce four.

Cultural notes

These three cultivars require well-drained organic substrate with a pH of 6.0 to 6.5. In the breeding program, a mix of 5 aged pine bark : 4 peat or peat substitute (currently coconut coir dust) : 1 coarse sand, modified subsequently to 25% total volume with coarse perlite, was used. It was amended with 5.0 $\text{kg}\cdot\text{m}^{-3}$ 17N-2.3P-10K Osmocote (Scott's, Milpitas, Calif.), 4.2 $\text{kg}\cdot\text{m}^{-3}$ dolomite, and 1.2 $\text{kg}\cdot\text{m}^{-3}$ Micromax (Scott's). The bulbs received monthly supplemental liquid applications of 300 $\text{mg}\cdot\text{L}^{-1}$ N, P, K from April through September. 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. The medium was not allowed to dry out during the growing season.

These cultivars were propagated successfully from twin-scale cuttings (Traub, 1953). Cuttings were soaked in 5-ethoxy-3-trichloromethyl-1,2,4-thiadiazole for 30 min before being placed in 1 peat : 1 perlite (v/v) in flats. The flats were covered with clear polyethylene covers and placed under 80% shade (maximum PPF = 400 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$), and bulblets were produced in 6 to 8 weeks (Table 4). The bulblets were transferred to small pots of the same growing substrate after they had developed one to two leaves.

Table 1. Parentage of *Hippeastrum* 'Bahia', 'Rio', and 'Sampa'.

Cultivar	Maternal parent	Paternal parent
Bahia	<i>Hippeastrum. pardinum</i> x <i>H. papilio</i>	<i>Hippeastrum</i> 'WhiteChristmas'
Rio	<i>H. papilio</i> x <i>H. ambiguum</i> 'Tweedianum'	<i>H. 'Dutch Belle'</i>
Sampa	<i>H. papilio</i> x <i>H. lapacense</i>	<i>H. 'Apple Blossom'</i>

Table 2. Flowering performance of *Hippeastrum* 'Bahia', 'Rio', and 'Sampa' under ambient south Florida conditions.

Cultivar	Year	n	Mean no. scapes per bulb (SD)	Mean no. flowers per scape (SD)
Bahia	1994	2	2.5 (0.7)	3.5 (0.7)
	1995	3	2.7 (0.7)	3.7 (0.5)
	1996	5	2.8 (0.4)	3.7 (0.5)
	1997	5	3.0 (0.0)	3.8 (0.4)
Rio	1994	2	2.0 (0.0)	3.5 (0.7)
	1995	3	2.0 (0.0)	3.6 (0.6)
	1996	5	2.0 (0.0)	4.0 (0.0)
	1997	5	2.0 (0.0)	4.0 (0.0)
Sampa	1994	2	3.0 (0.0)	5.2 (0.8)
	1995	4	3.5 (0.6)	5.8 (0.8)
	1996	6	3.5 (0.5)	6.6 (0.4)
	1997	8	3.5 (0.5)	6.8 (0.3)

Table 3. Flowering performance of *Hippeastrum* 'Bahia', 'Rio', and 'Sampa' treated according to the forcing protocols of Okubo (1993).

Cultivar	Year ^z	n	Mean no. scapes per bulb (SD)	Mean no. flowers per scape (SD)	Days to emergence of 1 st scape after treatment	Days to anthesis of 1 st scape after treatment
Bahia	1996	2	2.8 (0.4)	3.7 (0.5)	21, 26	40, 44
	1997	3	3.0 (0.0)	3.7 (0.5)	23, 23, 25	43, 41, 43
Rio	1996	2	2.0 (0.0)	3.8 (0.5)	18, 21	35, 41
	1997	3	2.0 (0.0)	3.7 (0.5)	20, 20, 24	38, 39, 45
Sampa	1996	2	3.0 (0.0)	5.2 (0.8)	19, 23	40, 43
	1997	3	3.3 (0.6)	5.6 (0.8)	21, 21, 25	39, 41, 43

^zForcing pretreatment began 15 Sept. and lasted for 8 weeks.

Table 4. Propagation of *Hippeastrum* 'Bahia', 'Rio', and 'Sampa' from twin scale cuttings in 1996.

Cultivar	Date cuttings taken	n	Mean no. days until bulblet for- (SD)	% Scales forming bulblets	Mean no. bulblets per cutting ^z (SD)
Bahia	15 Sept.	38	42.7 (4.9)	77	1.1 (0.3)
Rio	10 Sept.	53	38.3 (3.8)	80	1.2 (0.3)
Rio	15 Feb.	110	47.5 (3.4)	73	1.1 (0.2)
Sampa	13 Sept.	65	40.2 (5.1)	85	1.2 (0.2)
Sampa	19 Feb.	144	51.6 (4.2)	82	1.4 (0.4)

^zSuccessful cuttings only.

Bulbs were grown under open shade cloth at the Fort Lauderdale Research and Education Center. Consequently, we experienced higher pest pressure than would be the case in a greenhouse. Pest problems have included mealybug (*Pseudococcus* Westwood sp.) and scales [Florida wax scale, *Ceroplastes floridensis* Comstock; Magnolia white scale, *Pseudaulacapsis cockerelli* (Cooley)]. Bulbs in active growth, especially those grown outdoors or in open structures, should be in-

spected periodically for grasshoppers [(*Romalea guttata* (Latreille)], which can defoliate the plants. These cultivars exhibited foliar mottling for the first time in 1998, symptomatic of *Hippeastrum* mosaic virus. Protocols are available for producing virus-free stock from infected bulbs through micropropagation (Nowicki and O'Rourke, 1974, 1975). The cultivars were not highly susceptible to foliar infection by *Staganospora curtisii* (red scorch).

Availability

The Florida Agricultural Experiment Station has applied for U.S. and European patents on these cultivars. Licensing will be by the Florida Foundation Seed Producers, P.O. Box 309, Greenwood, FL 32443.

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