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Effects of Production Shade Levels and Cultivar Selection on Potted and Cut Caladium Performance in Interiorscapes

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Caladiums (*Caladium* × *hortulanum* Birdsey) are prized for their colorful foliage and are used mainly in relatively high light areas—both outdoors as summer bedding plants and indoors as potted florists' plants. In addition, caladiums are also used to a very limited extent in florists' arrangements. However, caladiums, especially recently developed cultivars, may have potential for use in lower light interiorscapes and as more durable cut foliages. Seven cultivars, four fancy-leaved and three strap/lance-leaved, were produced under two shade levels (50% and 88%) and evaluated under simulated home/office conditions for display life (potted florists' plants) and vase life (cut foliage). Display life ranged from 93 to 121 days with the strap/lance-leaved cultivar 'White Wonder' lasting the longest. Production shade level had a significant effect on display life with plants produced under 50% shade lasting 18% (17 days) longer than those produced under the heavier shade. Vase life ranged from 11.9 ('White Christmas') to 27.7 ('Candyland') days. The strap/lance-leaved cultivars lasted longer than the fancy-leaved ones. An interaction occurred between cultivar and production shade level—leaves of 'Florida Calypso' and 'Raspberry Moon' produced under 88% shade did not last so long as those produced under 50% shade. Production shade level did not affect the vase life of the other cultivars. Display and vase life results suggest that some recently developed caladium cultivars have potential for use in interiorscapes with relatively low light levels, both as potted florists' plants and cut foliages.

Caladiums are colorful herbaceous perennial plants that are used predominantly as outdoor summer bedding plants and, to a lesser extent, as potted florists' plants for use in high light situations. The recommendation for indoor use has been to "give them as much light as you can, without exposing them to direct sunlight" (Griffith, Jr., 2006). Most (90% to 95%+) of the worldwide caladium tuber production occurs in Florida (Deng et al., 2005). Despite the attractive appearance of the foliage, rivaling that of flowers for color and showiness, these plants have not been evaluated for use in low-light interiorscapes where many other members of the Araceae family (e.g., Aglaonema, Epipremnum, Philodendron, Spathiphyllum) perform very well. Although caladiums have long been suggested as excellent cut foliages (Benz and Johnson, 1986), their use has been very limited due to seasonal and restricted availability, and the lack of durable cultivars (Scace, 2001). New fancy-leaved cultivars have been introduced and more lance-leaved caladiums, which are often more durable and easier to use in flower arrangements (Black and Tjia, 2003), have become available. The purpose of these experiments was to evaluate some of these newer cultivars along with some older ones for use as potted florists' plants and cut foliages under simulated home/office conditions.

Materials and Methods

The *Caladium* × *hortulanum* Birdsey production shade level and interiorscape study was conducted at the University of Florida's Mid-Florida Research and Education Center in Apopka, FL. On 16 Mar. 2010, No. 1 (3.8–6.4 cm [1.5–2.5 inch]) tubers of seven cultivars, both fancy-leaved and strap/lance-leaved types (Table 1), were received. Five of the seven cultivars are patented.

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Table 1. Characteristics of caladiums used in interiorscape evaluations.

Cultivar	Leaf type	Leaf colors	Plant patent no.	Year patent issued	De-eyed
Candyland	Strap/lance	white, red, green	18,766	2008	yes
Florida Calypso	Fancy	green, red, pink	10,466	1998	yes
Freida Hemple	Fancy	red, green	np[z]	—	no
Raspberry Moon	Fancy	green, reddish pink	20,069	2009	yes
White Christmas	Fancy	white, green	np	—	yes
White Delight	Strap/lance	white, green	21,216	2010	yes
White Wonder	Strap/lance	white, green	21,044	2010	yes

[z]np = not patented.

Tuber preparation and planting. Tubers for six of the seven cultivars, excluding 'Freida Hemple' that has numerous buds (Evans and Harbaugh, 1993), were de-eyed on 9 Apr. 2010, and tubers of all seven cultivars were allowed to cure in an air conditioned room for 3 d. On 12 Apr. 2010, tubers were planted 3.8–5.1 cm (1.5–2 inches) deep in a peat-based (Canadian sphagnum peat moss—75% to 85% by volume) growing medium (Premier Pro-Mix BX, Mycorise Pro, Premier Horticulture, Quakertown, PA) in 15.2-cm (6-inch) standard pots (Dillen Products, Middlefield, OH).

Production shade levels. Directly after planting, pots were placed in a high-light greenhouse with a 50% production shade level factor. A combination preventative fungicide drench of mefenoxam (Subdue MAXX, Novartis Crop Protection, Greensboro, NC) and thiophanate-methyl (3336 WP, Cleary Chemical Corporation, Dayton, NJ) was applied on 13 Apr. 2010 to all pots at a rate of 236.6 mL/pot [8 fl oz/pot]. Plants were irrigated as needed and received liquid fertilization at 200 ppm of N from a 20N–8.7P–16.6K fertilizer (Peters Professional 20–20–20, The Scotts Co., Marysville, OH) at each irrigation. On 19 May 2010, ten plants of each cultivar were moved to a low-light greenhouse with an 88% production shade level factor. On 25 Jun. 2010, all pots were again treated with a second drench of the same fungicides at the same rates as on 13 Apr. 2010.

Interiorscape setup. On 29 Jun. 2010, three separate acclimatization rooms 3 m × 3 m (10 ft × 10 ft) were used for the two interiorscape trials; a potted display life trial (Rooms 1 and 2) and a cut-leaf vase life trial (Room 3). Each cultivar and production light level was represented per room and trial. Acclimatization room light levels and temperature were set to simulate a home/office environment. Fluorescent lamps (32W T8 Starcoat ECO, GE, Canada) provided a 12-h day and measured at 16 $\mu mol \cdot m^{-2} \cdot s^{-1}$ (Rooms 1 and 2) and 17 $\mu mol \cdot m^{-2} \cdot s^{-1}$ (Room 3) using a portable quantum meter (LI-185A, LI-COR, Lincoln, NE). Temperatures and relative humidities were recorded for Rooms 1 and 2 at 18 to 24 °C [64.4 to 75.2 °F] and 46% to 84%, respectively, and for Room 3 at 16 to 24 °C [60.8 to 75.2 °F] and 50% to 74%, respectively, using a hygrothermograph (CT485, White Box, Stamford, CT).

Potted indoor plant trial. Eight plants of each cultivar (four high-light; four low-light) were moved to and divided between Rooms 1 and 2 (Fig. 1), ensuring full representation of all cultivars and light levels in both rooms. Pot medium was kept evenly moist allowing a 10% to 30% leachate, which was removed from trays shortly after watering. Porometer readings of newly emerged mature leaves were taken 2 months apart and measured using a steady state porometer (LI-1600, LI-COR, Lincoln, NE) with a 2-cm^2 broadleaf aperture. Senescing leaves were pruned and counted per plant on a weekly basis through September, and bi-weekly through October. Display life termination of each plant was based on visual performance of foliage canopy, leaf turgor and leaf/plant health. The potted caladium trial ended on 1 Nov. 2010 (day 125), when all pots were considered no longer of acceptable display quality.

Cut-leaf vase life trial. For each cultivar and production light level combination, eight leaves—two from each of four plants—were cut using clippers and placed in a deionized water-filled container. Additional deionized water was added to the containers as needed. Cut-leaf days-to-wilt were determined visually by leaf (petiole and blade) turgor and overall appearance. The vase life trial ended on 5 Aug. 2010 (day 37) when the last cut leaf wilted.

Experimental design. Both interiorscape trials were 7 × 2 (caladium cultivar × production shade level) factorials with random complete block design. There were four replications for the potted plant trial and eight replications for the cut-leaf vase life trial.

Statistical analysis was done using GLM (Statistical Analysis System, SAS Institute, Cary, NC). Significance of main effects was determined using ANOVA and, where there were no interactions, differences in treatment means were determined using Duncan's new multiple range test at $P \leq 0.05$. With significant interactions, the dataset was decomposed and paired means differences were determined by ANOVA (F-test at $P \leq 0.05$).

Results and Discussion

Potted caladium display life. Cultivar and production shade level showed no significant interactions; therefore, only the main effects means are given (Table 2). Additionally, there were no differences in stomatal conductance and transpiration rates due to treatments (data not shown). Display life varied significantly by cultivar with 'White Wonder', a selection from a self-pollination of 'White Wing' (Hartman, 2010b), lasting longer than all other cultivars except 'White Delight'. 'White Delight', which has

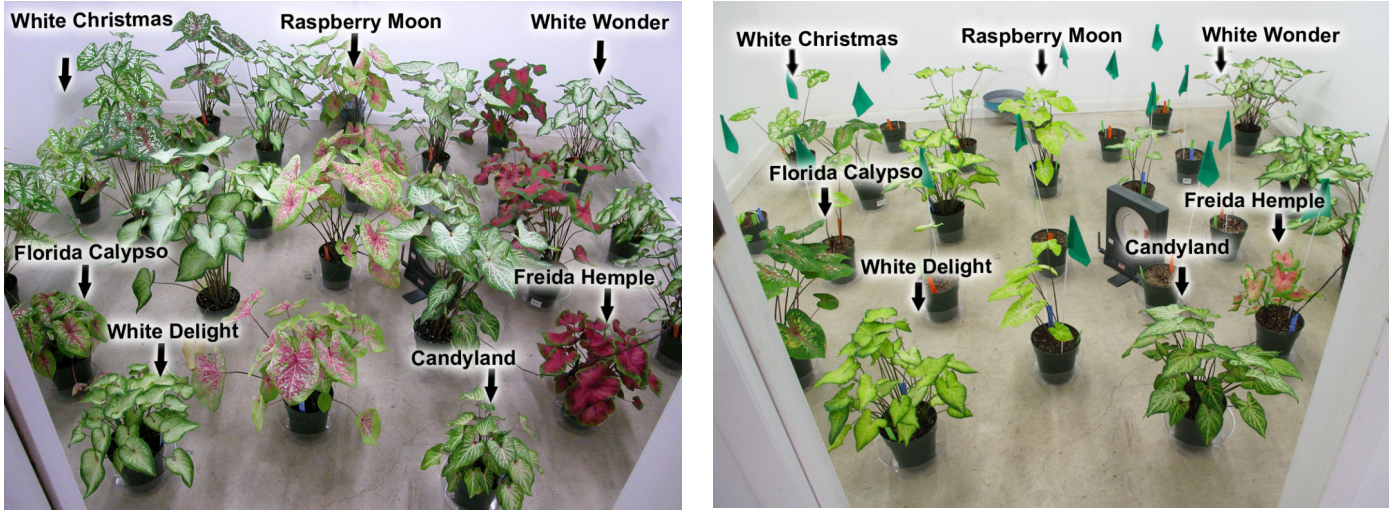

Fig. 1. Potted caladium plants in one of the acclimatization evaluation rooms near the beginning and end of the display life study.

Table 2. Cultivar selection and production shade levels affect potted caladium display life and number of senescing leaves pruned in interiorscapes.

Treatments			
Cultivar	Production shade level (%)	Display life (days)	Pruned leaves
Candyland		94.8 d[z]	35.4 ab
Florida Calypso		107.3 bc	32.1 b
Freida Hemple		102.6 bcd	33.6 b
Raspberry Moon		100.1 cd	31.9 b
White Christmas		92.9 d	44.8 a
White Delight		113.9 ab	42.6 ab
White Wonder		120.9 a	40.1 ab
	50	113.1 a	46.5 a
	88	96.1 b	27.9 b
Significance from ANOVA			
Cultivar		0.0001[y]	0.0441
Shade level		0.0001	0.0001
Cultivar × shade level		0.0903	0.3449

[z]Means separation for cultivars within columns by Duncan's new multiple range test at $P \leq 0.05$.
[y]*P* values determined by analysis of variance.

Table 3. Cultivar selection and production shade levels affect cut-leaf caladium vase life.

	Vase life (days)		
	Production shade level (%)		Production shade levels combined
Cultivar	50	88	
Candyland	29.5	25.9	27.7 a[z]
Florida Calypso	22.5	17.3[y]	19.9 b
Freida Hemple	16.6	16.3	16.4 b
Raspberry Moon	22.8	15.9[y]	19.3 b
White Christmas	14.9	9.0	11.9 c
White Delight	23.1	27.8	25.4 a
White Wonder	22.6	26.4	24.5 a
Significance from ANOVA			
Cultivar			0.0001[x]
Shade level			0.0732
Cultivar × shade level			0.0224

[z]Means separation within column by Duncan's new multiple range test at $P \leq 0.05$.
[y]Indicates that the mean vase life for that cultivar was shorter for leaves produced under 88% shade level as compared to 50% shade level by F-test at $P \leq 0.01$.
[x]*P* values determined by analysis of variance.

'White Wing' as its female parent (Hartman, 2010a), and 'White Wonder' are newly patented strap/lance-leaved cultivars and might be expected to hold up better than fancy-leaved cultivars (Black and Tjia, 2003). Interestingly, 'Candyland', the other strap/lance-leaved cultivar in this test, lasted only as long as the fancy-leaved cultivars; however, its average display life was still 3 months. Plants grown under 50% shade lasted, on average, 18% (17 days) longer in the indoor environment than plants grown under greater shade (88%). This is the opposite of what has been reported when several other members of the Araceae were acclimatized to lower light before being used in interiorscapes (Conover and Poole, 1984). It is unlikely that the acclimatization period was too short since it lasted six weeks and previous research on other aroids has shown significant reductions in light compensation points and dark respiration in as little as 3 to 4 weeks (Fonteno and McWilliams, 1978; Pass and Hartley, 1979).

As might be expected of strap/lance-leaved caladiums known to produce numerous leaves (Miranda et al., 2002; Wilfret et al., 2002), they were generally the ones that had the highest number of pruned leaves. However, fancy-leaved 'White Christmas' had the highest number and was the only cultivar significantly different from the (other) fancy-leaved cultivars. 'White Christmas' also had the shortest display life indicating that its leaves were rapidly senescing. The lack of large differences in the numbers of leaves produced by the cultivars may have been due in part to the fact that all tubers were of the same grade and all except 'Freida Hemple' were de-eyed prior to planting. Plants produced under the higher light level had 67% more leaves pruned yet had longer display lives suggesting that their nutritional status may have been better than that of the heavy shade-grown plants; such a difference could account for the greater leaf production (Druege, 2000).

Cut-leaf vase life. There was a highly significant ($P \leq 0.0001$) main effect of cultivar, but also a significant ($P \leq 0.02$) interaction between cultivar and shade (Table 3). Leaves of 'Florida Calypso' and 'Raspberry Moon' produced under 88% shade had shorter vase lives compared to their leaves that were produced under 50% shade. Production shade level did not affect the vase lives of the other five cultivars. Average vase lives by cultivar ranged from 11.9 to 27.7 d. Leaves from the strap/lance-leaved cultivars had longer vase lives than those of the fancy-leaved cultivars. 'White Christmas', the cultivar that performed the poorest in the potted display life study, had the shortest vase life.

The results from these experiments indicate that potted caladiums have potential to perform well under low light indoor conditions. In addition, the strap/lance-leaved cultivars appear to have potential for use as long-lasting cut foliages. Further evaluations would be useful to identify additional promising cultivars. The most long-lasting cultivars could then be used in future breeding programs directed specifically at producing caladiums for use in interioscapes. Successful breeding could result in the expansion of demand for caladiums.

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