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Research Paper

Acclimatization Potential of *Dracaena sanderiana* 'Victory' to Contrasting Light Environments

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Abstract

The present study was conducted to ascertain the ability of *Dracaena sanderiana* 'Victory', a foliage plant species of commercial importance in both domestic and international markets, to thrive under contrasting light environments. The experiment was carried out inside a semi-open greenhouse in Peradeniya, Sri Lanka. Same-sized and same-aged, ready-to-ship export quality plugs of *Dracaena sanderiana* 'Victory' were grown in plastic pots filled with the standard medium for foliage plants recommended by the Department of Agriculture. The plants were exposed to four different light treatments: Full sunlight, 15% shade under a green net, and 50% and 80% shade under a black net. Morphological and growth-related parameters were measured, and an aesthetic evaluation was done to verify the overall conformity of plants until 100 days after planting with every 20-day intervals. 'Victory' showed variable responses to different light conditions where leaf-related parameters were significantly altered, while the relative growth rate was kept uniform across light environments. Weight ratios that reflect the dry matter partitioning were unchanged. Most of the responses under the black net (50% shade) were comparable to those under the green net (15% shade), where the R: FR ratio was reduced. It was found that the plants could easily be acclimatized to the light conditions used in the present study. Interestingly, this cultivar scored more than 80% in the aesthetic evaluation for any given light condition, which indicates the potential of using this cultivar in heterogeneous light environments while keeping the aesthetic appearance unaltered.

Keywords: Aesthetic, Foliage plants, Low-maintenance, Shade.

INTRODUCTION

Some plants could be acclimatized to different environmental conditions, light in particular, with little quality changes. A plant's ability to acclimate to different light environments includes alterations both at the leaf level, associated with morphological, anatomical, and physiological characteristics, and at the whole-plant level, which is mainly related to the shoot architecture and biomass allocation patterns (Poorter, 2001). The acclimatization potential of plants to variable environmental cues is partially associated with 'low-maintenance', which is a rising concern among plant growers throughout the world. Comprehensive studies have evaluated the growth of forest tree seedlings at different irradiance levels with varying spectral qualities (e.g., Poorter, 1999; Muraoka *et al*., 1997). The literature pertinent to 'low-maintenance' plants, foliage plants in particular, is scarce, so the present study was conducted to ascertain the ability of *Dracaena sanderiana* 'Victory', a foliage plant species of commercial importance in both domestic and international markets (Beneragama and Peiris, 2016), to thrive under contrasting light environments. Specifically, this study tests the following hypotheses; (i) foliage ornamental plants such as *D. sanderiana* can be acclimatized to different light environments, (ii) light acclimatization potential of ornamental foliage plants will be displayed within a few months after exposure, and (iii) foliage acclimatization to variable light conditions integrates adjustments in plant morphology and physiology.

MATERIALS AND METHODS

The study was conducted in a semi-open greenhouse in Kiribathkumbura, Kandy (MW3b). Same-sized and same-aged, vegetatively propagated, ready-to-ship, export-quality plugs of *Dracaena sanderiana* (L.) Ker-Gawl. 'Victory' (hereinafter referred to as 'Victory') were obtained from a commercial floriculture farm. The selected plants were grown in plastic pots of 15 cm diameter. The medium used was the standard medium for foliage plants (loam soil 4: compost 2: cattle manure 1: sand 1) recommended by the Department of Agriculture of Sri Lanka (2002). The plants were fertilized with a 20:20:20 mixture (Cultisol F60® – Bower & Co) once every month and with an organic fertilizer (Maxicrop® – LANKEM) every two weeks. All the plants were watered based on the moisture depletion.

In this experiment, the plants were exposed to different light levels as four treatments including treatment 1: full sunlight (open), treatment 2: commercial 15% green shade net (green), treatment 3: commercial 50% black shade net (50%), and treatment 4: commercial 80% black shade net (80%). For the shading purpose, available commercial black polypropylene shade nets and common garden green shade net, which are popular among home gardeners in Sri Lanka, were used. The terminal leaves of all plants were marked at the beginning to observe the subsequent growth easily. The following observations were made at the time of field planting and thereafter at 25-day intervals, leaving two weeks for plants to get established prior to taking the first readings of chlorophyll content (using SPAD®, Minolta SPAD 502), leaf length and width, plant height, stem diameter, leaf area (using a leaf area meter, LI-COR®, Lincoln, Nebraska), dry weight, and root length. For the periods between successive harvests and for the whole treatment period, the following indices were calculated: relative growth rate (RGR), specific leaf area (SLA), specific leaf weight (SLW), leaf weight ratio (LWR), stem weight ratio (SWR), root weight ratio (RWR), and specific root weight (SRW). Though plant quality is a subjective phenomenon, this was used in this study to relate the overall conformity of the plant and thus, to evaluate the aesthetic quality for its intended purposes. For aesthetic evaluation of the plants, the point scheme for the determination of the quality of potted ornamental foliage plants proposed by Conover (1986) was used. All statistical analyses were done with the SAS software package (SAS Inc.).

RESULTS AND DISCUSSION

When 'Victory' was exposed to variable light environments, it was apparent that some of the leaf-related parameters were altered significantly (Table 1). The widest leaves were observed under 80% shade while open and green nets resulted in the narrowest leaves. This is a typical shade-tolerance response shown by some plants in response to shade (Valladares and Niinemets, 2008). Even though the leaves were thinner, the total leaf area was the highest under full sun, mainly due to the greater number of leaves produced. It has been reported that higher leaf production rates are achieved in response to higher irradiance levels in 'sun-loving' plants (King, 1994). This also supports the phenomenon of the shade-tolerance syndrome in 'sun-loving' plants. The highest mean leaf area under 50% is in agreement with a previous report in which moderate shading increased mean leaf area (Vladimirova *et al.*, 1997). Higher total leaf area either by having large, few leaves or small, many leaves is of great importance for the plant to thrive in different environments. Nevertheless, in the ornamental plant context, a good balance of foliar display is a key factor.

An increase in chlorophyll content under shade is another typical shade-tolerance response in plants (Griffith and Sultan, 2005). However, surprisingly, in the present study, chlorophyll content (SPAD values) did not change across light levels (Table 1). This result contradicts most of the findings related to shade-tolerance (e.g., Mishanin *et al.*, 2017), but corroborates the results put forward by Olsen *et al.* (2002). This indicates that 'Victory' does not show some of the most common shade-tolerance responses. Moreover, specific leaf weight did not change across light levels. This is consistent with the findings of Guglielmini and Satorre (2002) who demonstrated that leaf thickness in *Cynodon dactylon* was not affected by different light levels, but contradicts the findings of Steinbauer (2002). In the present study, as depicted by the same leaf weight ratio, 'Victory' invests equally on leaves irrespective of the light environment. This clearly shows the greater acclimatization potential of 'Victory' to contrasting light environments.

Table 2 shows the stem- and root-related responses of 'Victory' as affected by variable light environments. As was expected, the least root mass and length were observed in the plants grown under the 80% shade, which can also be considered as a typical response to shade (Valladares and Niinemets, 2008). However, these plants were able to maintain a similar root weight ratio across light levels. As was apparent with the results of having the longest internodes, the highest stem diameter, and the tallest plants, the biggest plants were observed under the full sunlight.

Table 1. The effect of different light environments on leaf attributes of *Dracaena sanderiana* 'Victory' 100 days after planting.

Light environment	Leaf length (cm)	Leaf width (cm)	Total leaf area (cm^2)	Mean leaf area (cm^2)	Total leaf dry weight (mg)	Mean leaf weight (mg)	Chlorophyll content (SAPD)	Specific leaf weight (mg)	Leaf weight ratio
Green	13.8 a	2.6 c	610 b	30.5 b	1578.9 b	78.9 c	43.8 a	2.6 a	0.39 a
Open	13.8 a	2.7 c	645 a	30.7 b	1717.8 a	81.8 b	42.3 a	2.7 a	0.38 a
50 %	14.2 a	2.9 b	565 c	33.2 a	1528.2 b	89.9 a	44.2 a	2.7 a	0.39 a
80 %	14.2 a	3.1 a	510 d	28.3 c	1341.4 c	74.5 d	42.5 a	2.6 a	0.41 a
P<	ns	0.01	0.05	0.05	0.01	0.01	ns	ns	ns
CV (%)	7.56	4.82	5.77	5.32	8.4	5.89	6.73	6.01	4.94

*In each column, means with similar letters are not significantly different (P<0.05) using the LSD test. Treatments: Open: Full sunlight; Green: 15% shad with a green net; 50 and 80%: Levels of shade with a black net. ns: non-significant.

Table 2. The effect of different light environments on root and stem attributes of *Dracaena sanderiana* 'Victory' 100 days after planting.

Light environment	Root dry weight (mg)	Root length (cm)	Root weight ratio	Intermodal length (cm)	Stem diameter (cm)	Plant height (cm)	Stem dry weight (mg)	Shoot weight ratio
Green	610.3 b	377.1 b	0.15 a	1.61 c	0.69 c	27.2 ab	1902.3 b	0.46 a
Open	732.7 a	703.5 a	0.16 a	1.87 a	0.85 a	28.55 a	2101.6 a	0.46 a
50 %	711.8 a	313.3 c	0.18 a	1.92 a	0.81 b	26.2 bc	1687.9 c	0.43 b
80 %	511.9 c	329.4 c	0.16 a	1.77 b	0.71 c	25.7 c	1441.3 d	0.44 ab
P<	0.05	0.05	ns	0.05	0.01	0.05	0.01	0.05
CV (%)	7.23	8.05	6.12	6.12	6.79	7.07	8.46	7.08

*In each column, means with similar letters are not significantly different ($P < 0.05$) using the LSD test. Treatments: Open: Full sunlight; Green: 15% shad with a green net; 50 and 80%: Levels of shade with a black net. ns: non-significant.

Table 3. The effect of different light environments on whole plant perspectives of *Dracaena sanderiana* 'Victory' 100 days after planting.

Light environment	Plant dry weight (mg)	RGR	Aesthetic score
Green	4091.5 b	13.72 a	88.1 b
Open	4552.1 a	14.26 a	91.2 a
50 %	3927.9 b	13.50 a	93.4 a
80 %	3294.6 c	12.48 a	84.9 c
P<	0.01	ns	0.05
CV (%)	9.57	6.68	7.29

*In each column, means with similar letters are not significantly different ($P < 0.05$) using the LSD test. Treatments: Open: Full sunlight; Green: 15% shad with a green net; 50 and 80%: Levels of shade with a black net. ns: non-significant.

The whole plant perspective is given in Table 3. The highest and the lowest plant dry weight was observed under full sunlight and 80% shade, respectively. Although the plants were different in terms of size, the RGR was the same irrespective of the light environment.

It has been observed that the foliage acclimatization was achieved around 40 days after the exposure (data not shown). The aesthetic evaluation revealed that plants were of high quality (scored more than 80) under all light environments although the differences among the treatments were significant.

CONCLUSION

Foliage ornamental plants such as *Dracaena sanderiana* 'Victory' can be acclimatized to different light environments with little quality differences within several weeks after introducing to a new light environment, so this variety can be suggested as one of the promising plants for low-maintenance landscapes. The foliage acclimatization to variable light conditions integrates adjustments in plant morphology and physiology.

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