Research Journal of Agriculture and Forestry Sciences _____ ISSN 2320-6063
Vol. **5(3),** 1-4, March **(2017)** *Res. J. Agriculture and Forestry Sci.*

Effect of graded shade levels on the growth and qualities of *Dracaena sanderiana* var. 'Celes'

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Available online at: www.isca.in, www.isca.me
Received 5th January 2017, revised 25th February 2017, accepted 3rd March 2017

Abstract

An experiment was carried out to evaluate the effects of graded shade levels on the growth and quality of Dracaena sanderiana var. 'Celes' in Batticaloa district of Sri Lanka. Graded shade levels were defined as treatments viz. 0% (T1), 50% (T2), 60% (T3), 70% (T4), and 80% (T5). The experiment was arranged in a completely randomized design with three replications. Experimental location was Crop Farm, Eastern University, Sri Lanka. Recommended agronomic practices were followed uniformly for all treatments. Plant height, leaf area, and plant biomass were measured at monthly interval and quality of cuttings was assessed at 3 months after transplanting. Analysis of Variance was performed to determine significant difference among treatments ($p < 0.05$). Plants grown at 70% shade level showed significantly ($p<0.05$) better performance in measured growth parameters viz. plant height, leaf area and biomass while the lowest performance was observed in plants grown at 80% (T5) shade level and open field condition (T1). In quality assessment, plants subjected to 70% shade received significantly ($p<0.05$) highest score. Plants grown at 70 % shade level would have received optimum amount of irradiation in this experiment. In conclusion, it could be stated that, 70% shade level is optimum for growing Dracaena sanderiana var. 'Celes' in the Batticaloa district of Sri Lanka.

Keywords: Biomass, Leaf area, Light stress, Plant height, Shade level.

Introduction

Floriculture industry in Sri Lanka has emerged as a reliable supplier of quality floriculture products worldwide. *Dracaena sanderiana* is a popular indoor plant with high demand in global market. Dracaena varieties are commercially produced in export-oriented large scale nurseries in Sri Lanka[1]. However, commercial nurseries are mainly found in the Western, North Western and Central Provinces[2]. Climatic requirements of *Dracaena sanderiana* varieties are compatible with the prevailing climatic conditions in the Batticaloa district of Sri Lanka. Therefore this crop can be selected as a foreign income earner to this area. Dracaena is a shade obligate plant[3]. Popularity of dracaena is attributed by colourful foliage and various leaf variegation patterns[4]. Light level influences the chloroplast development in leaves during the growth there by influence leaf colour and variegation[5]. Therefore optimum shade level is necessary in nurseries where, dracaenas are being grown. Shade levels influence the growth and quality of foliage ornamentals plants and provision of shade is recommended for the cultivation of foliage plants in Sri Lanka. Therefore specific researches are needed to identify optimum shade level for the cultivation of *D. sanderiana* var. "celes" in the Batticaloa district of Sri Lanka. Hence objective of this experiment was to determine the effects of graded shade levels on growth and quality of *D. sanderiana* var. "celes" and to select optimum shade level for the cultivation of *D. sanderiana* var. "celes" in the Batticaloa district of Sri Lanka.

Materials and methods

The experiment was conducted from October 2015 to March 2016 at the Crop Farm, Eastern University of Sri Lanka, Vantharumoolai, Batticaloa (7.7944° N, 81.5790° E, agro-ecological zone DL_2), Sri Lanka. Graded shade levels were defined as treatments viz. 0% (open sunlight -T1), 50% (T2), 60% (T3), 70% (T4), and 80% (T5). The experiment was arranged in a completely randomized design (CRD) with three replications. Each treatment contained thirty plants and an experimental unit consisted of one plant. Uniform, rooted and one month old cuttings of *D. sanderiana* var. "celes were obtained from a private nursery and were treated before planting with fungicide (Captan®) to avoid infections. The cuttings were planted in polybags filled with a potting medium composed of loamy soil, compost, cattle manure, and sand in a ratio of 4: 2: 1: 1 (volume basis). Plants were arranged at a spacing of 30 plants per m^2. All the management practices were followed uniformly for all treatment as per the recommendations. Destructive sampling was practiced. The measurements viz. plant height (cm), leaf area (cm^2) and biomass (g) were taken at monthly interval and quality of cuttings was assessed at 3 months after transplanting. Criteria suggested by Conover and Poole (1986) were used for quality evaluation. Analysis of variance was carried out to determine significant differences between treatments ($p<0.05$). Treatment means were compared using Tukey test at the 0.05 probability level. Scores obtained

from the quality evaluation of plants were analyzed through Mood's Median test at the 0.05 probability level.

Results and discussion

Plant height: Different shade levels influenced the plant height of *Dracaena sanderiana* 'Celes' significantly ($p<0.05$) (Table-1). At 5 months after transplanting (MAT), plants grown under open field had the lowest plant height among all the treatments, while the highest plant height was recorded on plants provided with 70% shading.

Table-1: Effect of different shade levels on plant height of Dracaena sanderiana var. 'Celes'.

Plant height (cm)					
Shade level	1MAT	2MAT	3MAT	4MAT	5MAT
0%	15.400b^{c}	16.367^{c}	19.167^{b}	20.433^{c}	23.866^{c}
50%	17.233^{a}	18.033^{a}	25.240^{a}	26.733^{a}	29.100^{b}
60%	16.767^{a}	17.133^{b}	23.100^{ab}	26.667^{a}	29.900^{ab}
70%	16.333^{ab}	17.100^{b}	23.000^{ab}	26.566^{a}	32.933^{a}
80%	15.133^{c}	16.000^{c}	20.466^{b}	22.967^{b}	24.333^{c}

Means followed by same letter in each column are not significantly different with the Tukey test at 5% level of probability. (n=3).

Dracaena plants grown at 0% and 80% of shade levels produced significantly lowest plant height at 5 MAT. In open field condition, plants had lowest height. Even though light is the ultimate substrate for photosynthetic energy conversion, it can also harm plants[6]. In open field, dracaena plants would have received excess amount of irradiation above their requirement. It might cause light stress on plants and consequently reduced the plant height. In 80% shade level, radiation received by the plants might be lower than their requirement. Higher shading reduced plant height in *Cyclamen persicum*[7]. Higher shade level affects the plant growth by reducing photosynthesis. The plants provided with 70% shade would have received optimum light for better growth. Optimum light level is important for maximum photosynthesis. Therefore the plant height was increased and there were no symptoms of etiolation. Carnation plants grown under 70% shading reached highest plant height compared to those grown at 0, 20, 40 and 60% shading[8]. In Moderate shade level, temperature and humidity also suitable for plant growth. Thus the plants reached highest plant height at 70% shade level.

Leaf area: Different shade levels significantly ($p<0.05$) influenced the leaf area of *Dracaena sanderiana* 'Celes' plants at 5 months after transplanting (MAT) (Table-2). Plants grown in 80% shading had the lowest leaf area while the highest leaf area was recorded in plants provided with 70% shading at 5 MAT.

Table-2: Leaf area of the Dracaena sanderiana var. 'Celes' under different shade levels at 5 months after transplanting.

Leaf area (cm^2)					
Shade level	1MAT	2MAT	3MAT	4MAT	5MAT
0%	85.823^{b}	120.336^{c}	148.316^{bc}	174.15^{b}	222.996^{c}
50%	145.003^{a}	174.236^{b}	175.606^{ab}	253.663^{a}	284.813^{b}
60%	149.166^{a}	176.023^{b}	210.316^{ab}	269.63^{a}	297.516^{ab}
70%	150.440^{a}	205.483^{a}	229.11^{a}	292.616^{a}	332.483^{a}
80%	48.743^{c}	66.900^{d}	87.993^{c}	125.596^{b}	157.903^{d}

Means followed by same letter in each column are not significantly different with the Tukey test at 5% level of probability. (n=3)

Growth of crops is related to the amount of solar radiation received during the growing period[9]. Crop growth was suppressed by reduced radiation levels. In 80% shade level, development of leaf area was significantly reduced in dracaena plants as radiation received by the plants was lower than their requirement. It caused reduction in photosynthesis process and growth. Eventually growth and leaf formation of the plants were suppressed in 80% shade.

Plants grown in open field condition (T1) also produced lower leaf area. A leaf which was exposed to plenty of light had sufficient amounts of food and won't need an excessive amount of chlorophyll. This enabled the leaf to have a small surface area. At higher irradiation levels there may also be chances for destruction of photosynthetic pigments in sensitive plants leaves[10]. Leaves of dracaena might be sensitive to higher irradiation levels and it could be the reason for reduction of leaf area under open field and 50% shade level.

Dracaena plants produced highest leaf area in shade level of 70%. It showed that 70% shade provided required amount of light for optimum growth of dracaena plants. This could be the possible reasons for highest leaf area of plants grown at 70 % shade level. The morphological changes of turf grasses grown under shade conditions include increases in leaf length, leaf area and leaf thickness[11]. Studies showing that shaded peppers have longer internodes, larger leaves, greater whole-plant leaf area, and thinner leaves[12].

Plant biomass: Different shade levels significantly ($p<0.05$) influenced the Biomass of *D. sanderiana* 'Celes' plants at 5 months after transplanting (MAT) (Table-3).

Table-3: Biomass of the Dracaena sanderiana var. 'Celes' under different shade levels at 5 months after transplanting.

Biomass (g)					
Shade level	1MAT	2MAT	3MAT	4MAT	5MAT
0%	3.037[b]	4.140[b]	7.190[b]	7.300[c]	7.680[d]
50%	4.590[a]	5.350[a]	7.623[b]	7.916[b]	8.913[c]
60%	5.100[a]	5.626[a]	7.8366[ab]	8.216[b]	10.180[b]
70%	5.233[a]	6.340[a]	8.536[a]	7.717[a]	12.406[a]
80%	1.583[b]	2.506[c]	4.466[c]	5.113[d]	5.830[e]

Means followed by same letter in each column are not significantly different with the Tukey test at 5% level of probability. (n=3)

Dracaena plants belong to 80% of shade level produced significantly lowest plant biomass while plants under 70% obtained highest plant biomass. Increasing leaf area index is one of the ways of increasing the capture of solar radiation by the canopy of plant and production of dry matter[13]. In this experiment, it could be stated that, plant biomass production were in accordance with the trend of variances for leaf area. Under high shade level dracaena varieties produced low number of leaves per plant due to sub optimal light intensity received by the plants[3]. Therefore, leaf area development was lower under 80% shade level.

The results showed that plants grown under open field conditions (T1) also produced lower plant biomass. Different plants have optimum requirements and both deficient and excessive light intensities are injurious[14]. Higher irradiance levels in plants can cause photo degradation of chromo pigments, with a decrease in photosynthesis causing in a decrease in the biomass[10]. Dracaena is a shade obligate plant and could be sensitive to higher irradiation levels, which would have caused destruction of photosynthetic pigments and subsequent reduction of biomass.

The highest plant biomass was obtained in 70% shade level. It showed that the plants grown under 50% shade would have received optimum light for better growth. Therefore, their growth rate and carbon assimilation were at highest level. This might be the reason for highest biomass produced by the plants in 70% shade level. Moderate shade had a strongly facilitative effect on plant growth[15].

Quality of plants: The quality of plants was significantly influenced by different shade levels (Table-4). Dracaena plants grown at 70% shade level (T4) obtained significantly highest median while significantly lowest median was received by control (T1) plants.

Table-4: Quality analysis of *Dracaena sanderiana* var. 'Celes'.

Shade level (%)	Median
0%	20.5
50%	44.5
60%	66.5
70%	89.0
80%	28.0
P value	0.00

n=10

Colour of leaves, leaf expansion, shoot elongation, number of leaves in a cuttings are the main quality parameters of a foliage plants[16]. Plants grown at open sunlight and 80% shade level would have received excess and reduced amount of irradiation beyond their requirement respectively. Plants grown at open sunlight developed pale green colour foliage. Higher irradiance level in shade obligate plants can cause photo degradation of chromo pigments[10]. At high light levels, plants have lower chlorophyll content[17]. Plants grown at 80% shade level developed dark green colour foliage in 80% shade level plants would have received sub optimum level of light. Increased light absorption is brought about by increased number of chloroplasts as an adaptation to shade[5]. These might be the reasons for low quality of plants in open sunlight and 80% shade level. Plants grown at 70% of shade level would have received optimum amount of irradiation for better quality. This might be the reason for highest score obtained by the plants grown at 70% shade level.

Conclusion

Dracaena sanderiana var. 'Celes' plants grown at 70% shade level showed better performance in growth parameters such as plant height, leaf area and biomass. Further, plants subjected to 70% of shade level received better score in quality assessment. Lower (80% of shade level) and higher (open sunlight) light levels reduced the growth and quality of Dracaena plants. From this experiment, it could be concluded that 70% shade level is optimum for growing *Dracaena sanderiana* variety 'Celes' in the Batticaloa district of Sri Lanka.

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