Int.J.Curr.Microbiol.App.Sci (2017) *6*(12): 1984-1994

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 12 (2017) pp. 1984-1994**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.612.228

Influence of Light Intensity and Seasonal Variations on Yield and Quality of Selected Cut Foliage Crops

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Keywords

Cut foliage, Shade nets, Light intensity, Seasonal variations, Vase life.

Article Info

Accepted:
15 October 2017
Available Online:
10 December 2017

A B S T R A C T

Dracaena reflexa var. Variegata, *Dracaena reflexa* var. Green, *Melaleuca bracteata* and *Philodendron* 'Xanadu' plants were grown under green polypropylene shade nets permitting different light levels 388.50 to 647.50 µ mol $m^{-2}s^{-1}$ (25% shade net), 314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade net) and 240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade net) for two consecutive years at ICAR-IIHR, Hessaraghatta. The optimum light levels and seasonal variations on cut foliage production and quality were evaluated. *Dracaena reflexa* var. Variegata, *Dracaena reflexa* var. Green and *Melaleuca bracteata* performed well under the light intensity range of 388.50 to 647.50 µ mol m^{-2} s^{-1} (25% green shade net) for cut foliage production. *Philodendron* 'Xanadu' yielded maximum number of superior quality cut foliage when cultivated in the light intensity range of 240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade net). The production was the highest during winter months in *Dracaena reflexa* var. Variegata, *Dracaena reflexa* var. Green and *Philodendron* 'Xanadu' and during the summer months in *Melaleuca bracteata*. Peak production during the winter months is favourable for the growers to export the cut foliage to countries having severe winter but the demand is huge during the festive season.

Introduction

Cut foliage are used as fillers along with flowers in bouquets, floral arrangements, floral ornaments or alone to create variability in colours, textures shapes and forms of the foliage. The cut foliages are in demand throughout the year and comprise 10% of world floriculture trade with an annual growth rate of 4%. Statistics indicated that 25-30% of bouquets presently consist of foliage as compared to only 5% of foliage used 15 years ago. According to Whelton (2006) this trend is set to increase further because of the green, healthy image presented by such products and because of the predicted increase in consumption of floral products. The leading markets for foliage in the EU are the UK, Germany, France, Italy, The Netherlands, Poland and Spain. The major suppliers include Costa Rica, Guatemala, China, Sri Lanka, India, Mexico and South Africa. The best export window for foliage suppliers in developing countries is during the period October-May. Due to the seasonality of production, supplies from European Union growers are considerably lower during the winter months. Most foliage from developing countries is imported by specialised Dutch importers. In India *Asparagus* spp. comprise

of the major portion of the cut foliage trade. A number of other tropical foliage are grown on a lesser scale and are traded in lower volumes in spite of having a good potential. The amount of light that a plant receives has a tremendous impact on plant quality and marketability. Photosynthetic energy capture provides green plants with almost all of their chemical energy, and is central to their ability to compete and reproduce. Light levels affect survival of foliage plants as in ostrich fern (*Matteuccia struthiopteris* (L.) Todaro) where the survival decreased with increasing light intensity with only 22 per cent survival under full light (Donelan and Corey, 1994). Comparative studies of the growth and cut foliage yield response of plants grown under high and low light levels of irradiance have provided crucial insights (Givnish *et al.*, 1988**).** Knowledge on seasonal pattern of cut foliage growth and yield is also very important.

A survey of the growers, markets and florists was undertaken and some of the lesser cultivated but potential cut foliage *viz*., *Dracaena reflexa* var. Variegata, *Dracaena reflexa* var. Green, *Melaleuca bracteata* and *Philodendron* 'Xanadu' were identified and evaluated to standardise their light requirement and seasonal influence on cut foliage production and quality. Crop diversification to make available alternate foliage to the consumers was an important criterion in the selection of these foliage crops.

Materials and Methods

The studies on the influence of varying light intensities and seasons on yield and quality of cut foliage was conducted in the Division of Floriculture and Medicinal Crops, ICAR-Indian Institute of Horticultural Research, Hesaraghatta, Bengaluru during two consecutive years from 2011-13. *Dracaena reflexa* var. Variegata, *Dracaena reflexa* var. Green, *Melaleuca bracteata* and *Philodendron* 'Xanadu' were evaluated to identify the optimum light levels for cut foliage yield and quality. The plants were grown under green polypropylene shade nets permitting different light levels *i.e.*, 388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade net), 314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade net) and 240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade net) and the treatments were replicated thrice.

Uniform rooted cuttings of the first three plant species and healthy suckers of *Philodendron* 'Xanadu' were planted in two row system at 60 x 45 cm spacing. The soil of the experimental plot was red clay loam and the chemical analysis recorded initial organic carbon content (0.58%), available N (160 kg/ha), available P (85 kg/ha), available K (250 kg/ha), pH (6.3) and EC (0.28 dsm^{-1}). Fertiliser application to the plants was @ 100:30:60 kg NPK ha^{-1} per year wherein the entire dose of phosphorous was applied as basal dose and nitrogen and potash were applied in six equal split doses at bimonthly intervals.

The statistical design used was FRBD with three shade levels as the first factor and three seasons (summer, rainy and winter) as the second factor. Vase life of *Dracaena reflexa* var. Variegated, *Dracaena reflexa* var. Green, *Philodendron* 'Xanadu' and *Melaleuca bracteata* cut foliage grown under different shade levels was evaluated in distilled water under room condition (temperature 26^{o}C-29^{o}C and RH of 55-62%). Observations were recorded on the cut foliage production and quality of the cut foliage.

The effect of seasons on the cut foliage yield and quality of the crops were also recorded and the data was pooled, statistically analysed (Gomez and Gomez, 1984) and the results have been presented.

Results and Discussion

Dracaena reflexa var. Variegata

In *Dracaena reflexa* var. Variegata (Table 1a) significant differences were recorded on the number of harvestable branches per plant per year, length of branch, number of leaves per branch and internodal length with respect to the seasonal variations. The light intensity levels under different shade nets had no significant influence on the yield and foliage quality characters. This was contrary to the findings in *Dracaena* that the plants grown under 80 per cent shade were tallest, followed by those grown under 63 per cent, 47 per cent and 91 per cent shade.

The number of leaves per plant in *Dracaena* varied with shade treatments and plants under 63 per cent shade had the highest number of leaves (Vladimirova *et al.,* 1997). Among the three seasons, maximum number of harvestable branch per plant per year was produced during the winter months (6.42) followed by rainy months (5.76) and minimum (4.66) was recorded in the summer months. Length of branch was the highest during winter months (33.16 cm) followed by rainy season (32.38 cm) and least length of branch was noticed in summer months (25.78 cm).

Maximum number of leaves per harvestable branch was observed in rainy season (37.16) and was at par with winter months (36.69) and minimum number of leaves per harvestable branch was observed in summer months (27.45). Internodal length was the highest during summer months (1.65 cm) followed by rainy season (1.29 cm) and it was lowest during winter months (0.86 cm). The interaction effect of different light levels with three seasons was highly significant for internodal length (Table 1b). The internodal length was maximum (1.89 cm) under the light level of 388.50 to 647.50 µ mol $m^{-2}s^{-1}$ (25% shade) during summer months followed by 314.5 to 481µ mol $m^{-2}s^{-1}$ (50% shade) and 240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade) as compared to other seasons. The internodal length was minimum across all shade levels during winter months.

More number of branches per plant under 25% shading could probably be attributed to increased photosynthesis and consequently sugars, which stimulated more lateral bud sprouting. Increasing shading to 75% probably reduced light to below optimal level for photosynthesis, hence the reduction in lateral shoot formation in *Dracaena*. Similar results were observed by Hlatshwayo and Wahome (2010) in carnation. *Dracaena reflexa* var. Variegata had a longer vase life of 26.4 days under 75% of shade level followed by 24.8 and 22.2 days for cut foliage grown under 50% and 25 % shade levels respectively (Fig. 1).

Dracaena reflexa var. Green

The light intensity levels had no significant influence on the cut foliage growth and yield of *Dracaena reflexa* var. Green (Table 2a) while the seasons had significant influence on the number of harvestable branches per plant per year, length of branch, number of leaves per branch and internodal length. This is contrary to the report in *Dracaena reflexa*, pot plants, that the media composition of Soil + Sand + FYM @ 2:1:1 grown under 30% shade resulted in maximum plant height and highest number of leaves (Sarkar *et al.,* 2016). Among the three seasons, the highest number of harvestable branches per plant per year (7.36) was noticed during winter months followed by rainy season (7.26) and least number of harvestable branches per plant per year (6.01) was recorded during summer months. The maximum length of branch (37.23 cm) and number of leaves per

harvestable branch (39.45) was observed during rainy months followed by winter months (31.54 cm and 34.17 respectively) and least length of branch of 25.30 cm and number of leaves of 33.16 was recorded during summer months. Internodal length was the highest during summer months (2.43 cm) followed by rainy months (2.14 cm) and lowest internodal length was noticed during winter months (0.95 cm). Interaction effect of shade levels and season was not significant on growth and yield parameters of *Dracaena reflexa* var. Green (Table 2b). Among different shade levels tried, 75% of shade level gave longer vase life of 31.2 days followed by 29.6 and 27.0 days of vase life with cut foliage grown under 50% and 25 % shade levels respectively (Fig. 1). Higher light and temperature levels under 25% shade might have increased photosynthesis resulting in higher rate of growth and development in *Dracaena.* The plants grown under higher irradiance level generally have higher photosynthetic rates per unit area at those levels than do plants restricted or acclimated to low irradiance levels and vice versa (Bjorkman *et al.,* 1972a, 1972b: Jurik *et al.,* 1979; Bjorkman, 1981).

Philodendron 'Xanadu'

The varying levels of light had significant effect on the cut foliage quality like leaf length, width and length of petiole (Table 3a). Maximum leaf length (33.69 cm) and leaf width (4.81cm) was recorded in light intensity 240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade) which were on par with 50% shade levels (33.69 cm and 4.74 cm respectively). Length of petiole was maximum in 50% shade level (19.30 cm) but was at par with 75% shade level (19.00 cm). This finding corroborates the observation of Singh *et al.,* (2014) that vigorous growth of *Nephrolepis exaltata* (L.) Schott cv. Bostoniensis was obtained under 75 per cent shade and the plants produced the highest numbers of fronds, whereas frond length and mean lamina length were higher under 50 per cent shade. In leather leaf fern, leaf petiole, blade length and blade area increased with shading and of 35-70 per cent shade under plastic greenhouse conditions was suitable for cut leaf production (Cervelli *et al.,* 2003). Fan *et al.,* (1998) also reported that plants of *Spathiphyllum palls* grown under increasing shade levels showed increased plant height. The production of foliage was however not significantly influenced by the different light levels. Seasonal influence on the production and quality of cut foliage was found to be significant. Winter season recorded the maximum number of cut foliages per plant (305.02), leaf length (34.16 cm), leaf width (4.85 cm) and petiole length (20.58 cm) followed by rainy season for all the characters. Summer season recorded the least cut foliage production and quality across the varying light levels. The interaction effects between the light levels and seasons were non-significant (Table 3b). Maximum vase life of *Philodendron* 'Xanadu' cut foliage (23.66 days) was obtained with cut foliage grown under 50% shade levels and was at par with 20.13 days of vase life with foliage grown under 75% shade level. Cut foliages grown under 25% of shade level had the least vase life of 18 days (Fig. 1). *Philodendron* being adapted and naturalised to grow under the dense forest canopy might have a low irradiance requirement and hence the requirement for higher shade levels for optimum growth and development. Whole plant growth and competitive ability depend not only on the photosynthetic rate of individual leaves, but also on the geometry and dynamics of a plant canopy and the pattern of energy allocation among all organs. Several features of the plant form, physiology and resource allocation vary with level of irradiance to which plants are acclimatized and or ecologically restricted.

Table.1a Influence of light intensity and season on cut foliage yield and quality of *Dracaena reflexa* var. Variegata

Light intensity	**Number of harvestable branches/ plant/ year**	**Length of branch(cm)**	**Number of leaves/ harvestable branch**	**Internodal length (cm)**
388.50 to 647.50 µ mol m^{-2} s^{-1} **(**25% shade)	5.73	30.53	34.49	1.39
314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	5.65	29.83	33.45	1.31
240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	5.47	30.95	33.35	1.11
SeM (±)	0.14	0.7	0.91	0.09
CD (p=0.05)	**NS**	**NS**	**NS**	**NS**
Season				
Summer	4.66	25.78	27.45	1.65
Rainy	5.76	32.38	37.16	1.29
Winter	6.42	33.16	36.69	0.86
SeM (±)	0.14	0.7	0.91	0.09
CD (p=0.05)	**0.43**	**2.11**	**2.72**	**0.27**

Table.1b Interaction effect of light intensity and season on cut foliage yield and quality in *Dracaena reflexa* var. Variegata

Character	**Light intensity**	**Summer**	**Rainy**	**Winter**
Number of harvestable branches/ plant/ year	388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade)	4.98	5.93	6.27
	314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	4.49	5.9	6.54
	240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	4.51	5.46	6.45
SeM (±)		**0.25**		
CD (p=0.05)		**NS**		
Length of branch(cm)	388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade)	27.29	32.13	32.16
	314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	23.32	32.81	33.36
	240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	26.73	32.19	33.95
SeM (±)		**1.21**		
CD (p=0.05)		**NS**		
Number of leaves/ harvestable branch	388.50 to 647.50 µ mol m^{-2} s^{-1} **(**25% shade)	28.97	38.88	35.62
	314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	26.68	36.48	37.19
	240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	26.69	36.12	37.25
SeM (±)		**1.58**		
CD (p=0.05)		**NS**		
Internodal length (cm)	388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade)	1.89	1.37	0.9
	314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	1.72	1.37	0.84
	240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	1.35	1.14	0.83
SeM (±)		**0.16**		
CD (p=0.05)		**0.05**		

Table.2a Influence of light intensity and season on cut foliage yield and quality of *Dracaena reflexa* var. Green

Light intensity	**Number of harvestable branches/ plant/ year**	**Length of branch(cm)**	**Number of leaves/ harvestable branch**	**Internodal length (cm)**
388.50 to 647.50 µ mol m^{-2} s^{-1} **(**25% shade)	6.71	32.06	35.39	1.83
314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	6.54	29.47	34.94	1.79
240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	7.37	32.54	36.46	1.90
SeM (±)	0.37	1.07	0.83	0.11
CD (p=0.05)	**NS**	**NS**	**NS**	**NS**
Season				
Summer	6.01	25.30	33.16	2.43
Rainy	7.26	37.23	39.45	2.14
Winter	7.36	31.54	34.17	0.95
SeM (±)	**0.37**	**1.07**	**0.83**	**0.11**
CD (p=0.05)	**1.11**	**3.01**	**2.51**	**0.34**

Table.2b Interaction effect of light intensity and season on cut foliage yield and quality in *Dracaena reflexa* var. Green

Character	**Light intensity**	**Summer**	**Rainy**	**Winter**
Number of harvestable branches/ plant/ year	388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade)	5.37	6.59	8.18
	314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	6.19	6.76	6.68
	240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	6.47	8.42	7.23
SeM (±)		**0.64**		
CD (p=0.05)		**NS**		
Length of branch(cm)	388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade)	24.64	39.59	31.95
	314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	24.03	34.86	29.52
	240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	27.24	37.22	33.15
SeM (±)		**1.74**		
CD (p=0.05)		**NS**		
Number of leaves/ harvestable branch	388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade)	31.31	40.56	34.29
	314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	32.47	38.63	33.73
	240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	35.71	39.16	34.5
SeM (±)		**1.45**		
CD (p=0.05)		**NS**		
Internodal length (cm)	388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade)	2.34	2.21	0.94
	314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	2.3	2.1	0.95
	240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	2.65	2.12	0.94
SeM (±)		**0.19**		
CD (p=0.05)		**NS**		

Table.3a Influence of light intensity and season on cut foliage yield and quality of *Philodendron xanadu*

Light intensity	**Number of cut foliage plant/year**	**Length of leaf(cm)**	**Leaf width (cm)**	**Length of petiole (cm)**
388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade)	253.69	30.34	4.39	16.80
314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	218.48	33.19	4.74	19.30
240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	234.13	33.69	4.81	19.00
SeM (±)	10.34	0.42	7.46	0.46
CD (p=0.05)	**NS**	**1.26**	**0.22**	**1.39**
Season				
Summer	175.90	31.49	4.45	16.81
Rainy	225.38	31.57	4.63	17.70
Winter	305.02	34.16	4.85	20.58
SeM (±)	10.34	0.42	7.46	0.46
CD (p=0.05)	**31.02**	**1.26**	**0.22**	**1.39**

Table.3b Interaction effect of light intensity and season on cut foliage yield and quality in *Philodendron xanadu*

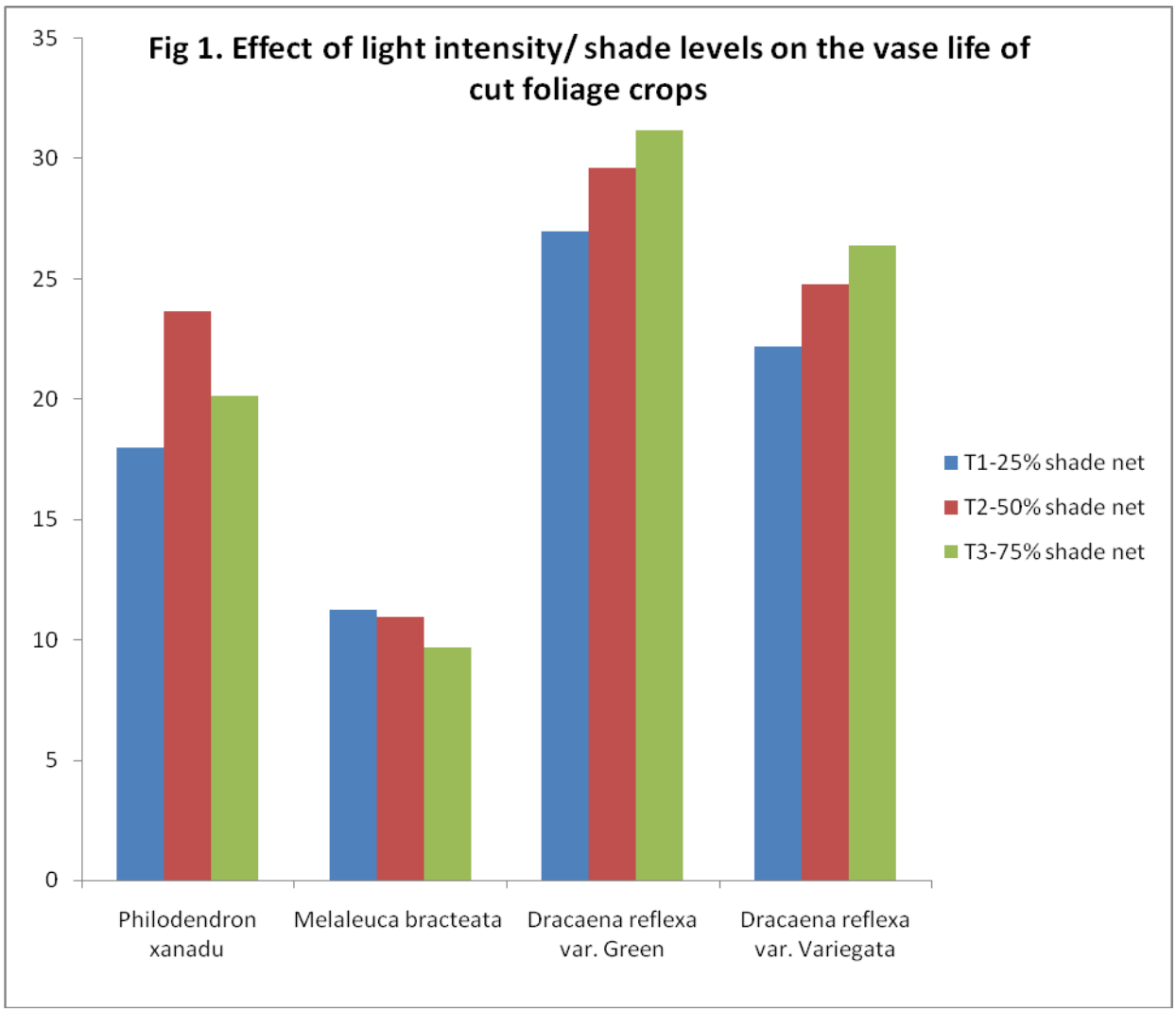
Character	**Light intensity**	**Summer**	**Rainy**	**Winter**
Number of cut foliage/ plant/ year	388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade)	199.99	225.2	335.88
	314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	155.54	222.78	277.14
	240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	172.18	228.17	302.03
SeM (±)		**17.92**		
CD (p=0.05)		**NS**		
Length of leaf(cm)	388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade)	29.51	29.36	32.15
	314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	33.01	31.88	34.68
	240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	31.96	33.45	35.66
SeM (±)		**0.72**		
CD (p=0.05)		**NS**		
Leaf width (cm)	388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade)	4.14	4.35	4.67
	314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	4.54	4.71	4.96
	240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	4.68	4.84	4.92
SeM (±)		**0.80**		
CD (p=0.05)		**NS**		
Length of petiole (cm)	388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade)	15.60	16.13	18.68
	314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	17.46	18.97	21.46
	240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	17.37	18.01	21.61
SeM (±)		**0.13**		
CD (p=0.05)		**NS**		

Table.4a Influence of light intensity and season on cut foliage yield and quality of *Melaleuca bracteata*

Light intensity	**Number of harvestable branches/ plant/ year**	**Length of branch(cm)**	**Number of primary branches/ plant**	**Intenodal length (cm)**
388.50 to 647.50 µ mol m^{-2} s^{-1} **(**25% shade)	23.97	73.14	11.86	5.66
314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	21.55	68.98	11.43	4.95
240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	18.58	68.38	11.09	5.26
SeM (±)	0.64	1.02	0.37	7.51
CD (p=0.05)	**1.93**	**3.04**	**NS**	**0.23**
Season				
Summer	25.06	65.96	11.05	5.02
Rainy	20.60	70.00	10.63	4.99
Winter	18.45	74.53	12.70	5.86
SeM (±)	**0.64**	**1.02**	**0.37**	**7.51**
CD (p=0.05)	**1.93**	**3.04**	**1.06**	**0.23**

Table.4b Interaction effect of light intensity and season on cut foliage yield and quality in *Melaleuca bracteata*

Character	**Light intensity**	**Summer**	**Rainy**	**Winter**
Number of harvestable branches/plant/ year	388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade)	27.33	24.5	20.09
	314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	25.73	20.06	18.86
	240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	22.11	17.24	16.39
SeM (±)		**1.12**		
CD (p=0.05)		**NS**		
Length of branch(cm)	388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade)	68.62	73.05	77.74
	314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	65.97	68.25	72.73
	240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	63.3	68.7	73.13
SeM (±)		**1.76**		
CD (p=0.05)		**NS**		
Number of primary branches/plant	388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade)	10.82	11.25	13.5
	314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	11.08	10.33	12.89
	240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	11.25	10.31	11.71
SeM (±)		**0.64**		
CD (p=0.05)		**0.39**		
Internodal length (cm)	388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade)	5.45	5.7	5.84
	314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade)	4.68	4.6	5.56
	240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade)	4.93	4.68	6.17
SeM (±)		**0.13**		
CD (p=0.05)		**NS**		



Melaleuca bracteata

Light intensity levels had significant influence on the number of cut foliage, length of branch and the internodal length of *Melaleuca bracteata* (Table 4). The maximum number of harvestable branches per plant per year (23.97) was recorded by plants grown under the light level of 388.50 to 647.50 µ mol m^{-2} s^{-1} (25% shade) followed by 21.55 under the light level of 314.5 to 481 µ mol $m^{-2}s^{-1}$ (50% shade) whereas the light level of 240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade) recorded the minimum value of 18.58 for this parameter. The maximum length of branch (73.14 cm) was recorded in the plants grown under the light levels of 25% shade whereas minimum length of branch (68.38 cm) was recorded under 75% shade. Internodal length was the highest in the plants grown under 25% shade (5.66 cm) followed by the light level of 75% shade (5.26 cm) and lowest under 50% shade (4.96 cm). Maximum number of harvestable branches per plant per year was produced during the summer months (25.06) followed by rainy months (20.60) and least number (18.45) in the winter months. Length of branch was the highest in winter months (74.53) followed by rainy (70.00) and lowest during summer months (65.96). Number of primary branches was the highest in winter months (12.70) followed by summer (11.05) and lowest in rainy months (10.63). Internodal length was the highest in winter

months (5.86 cm) followed by summer (5.02 cm) and least in rainy months (4.99 cm). The interaction effect of different light levels with the three seasons was significant for the number of primary branches (Table 4a). The number of primary branches was maximum (13.50) during winter under 25% shade levels followed by 50% shade levels during winter months (12.89).

The lowest number of primary branches was recorded in rainy season under 75% shade (10.31). *Melaleuca bracteata* foliage harvested at yellow green stage had longer vase life of 14 days as compared to foliage harvested at coppery tinge tip (12 days) and dark green stages (8 days) which exhibited drooping and shedding respectively. Maximum vase life of 11.72 days was obtained with plants grown under 75% shade level as compared to 10.66 days and 9.82 days under 50% and 25% respectively (Fig. 1).

Several features of the plant form, physiology and resource allocation vary with level of irradiance to which plants are acclimatized and or ecologically restricted. The plants grown under higher irradiance level generally have higher photosynthetic rates per unit area at those levels than do plants restricted or acclimated to low irradiance levels and vice versa. Presence of higher levels of RuBisCo enhances photosynthesis under higher irradiance levels and might be the reason for the increased yield in *Melaleuca bracteata* during summer seasons. Length of branch, number of primary branches and internodal length was highest in winter months. This might be due to the fact that the plants grown under low light conditions try to increase the light interception by increasing area by increasing the length of the branch and produces thin and pliable lengthy branches. Cermeno *et al.,* (2001) also reported that, a moderate reduction of radiation increased stem length in chrysanthemum. *Dracaena reflexa* var. Variegata, *Dracaena reflexa* var. Green and *Melaleuca bracteata* can be cultivated in the light intensity range of 388.50 to 647.50 µ mol m^{-2} s^{-1} (25% green shade net) and *Philodendron* 'Xanadu' in the light intensity range of 240.50 to 370 µ mol $m^{-2}s^{-1}$ (75% shade net). The yield of *Dracaena reflexa* var. Variegata, *Dracaena reflexa* var. Green and *Philodendron* 'Xanadu' was the maximum during the winter months, the possibility of exporting these cut foliage to the European and other markets which have severe winters and also have demand for foliage during the festive seasons can be explored by the growers. *Melaleuca bracteata* however is a potential crop for the summers. Crop diversification from the widely grown *Asparagus* to these lesser grown crops will help the farmers increase their income and reduce market glut. Intercropping under plantation crops permitting the required light intensity is also an option for increasing the profitability for farmers per unit area.

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How to cite this article:

Sujatha A. Nair, T. Usha Bharathi and Sangama. 2017. Influence of Light Intensity and Seasonal Variations on Yield and Quality of Selected Cut Foliage Crops. *Int.J.Curr.Microbiol.App.Sci.* 6(12): 1984-1994. doi: https://doi.org/10.20546/ijcmas.2017.612.228