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Evaluation of Coloured Shade Nets and Nutrients on Vegetative Parameters of Pot Foliage and Living Wall Plant *Cordyline terminalis* in Rainy Season

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ABSTRACT: The present study was achieved to evaluate the influence of different colour shade nets (white and green) with 50% shade along with control (without shade net) and nutrients *viz*., NPK 19:19:19 @ 1% (0.25 % at monthly intervals for 4 months) and 2% (0.25 % at fortnight intervals) on vegetative parameters of *Cordyline terminalis*. This experiment was laid out in Completely Randomized Design (CRD) with three replications in the Department of Floriculture & Landscaping, College of Agriculture, OUAT, Bhubaneswar during 2018-19. *Cordyline terminalis* grown under white shade net with foliar application of NPK 19:19:19 @ 1% exhibited best performance for vegetative growth parameters in terms of plant height (38.01) cm, internode length (4.81) cm, petiole length (12.60) cm, chlorophyll content (56.65), leaf area (73.51 cm^2) and number of leaves per plant (27.36) during rainy season. White shade nets were found superior in improving vegetative parameters and hence they can be used in place of the commercially used green shade net for improved growth of Cordyline. The revealed data can be utilized for more advanced studies for improvement of living wall and pot foliage. Peak production during rainy season is favorable for the growers to produce foliage plants for vertical gardening.

Keywords: *Cordyline terminalis*, colour shade nets, foliar application, vegetative parameters, living wall, pot foliage, rainy season, vertical gardening.

INTRODUCTION

In recent years, the integration of greenery into urban spaces has gained significant attention due to its positive impact on environmental aesthetics, air quality, and overall well- being. Living walls and pot foliage have emerged as popular choices for vertical landscaping, contributing to the greening environments. Foliage plants are commonly grown for their unique leaf shapes, colours, textures and patterns that make them visually attractive and that can be retained for longer period in an interior environment. *Cordyline terminalis* popularly known as "Ti" plant is an evergreen leafy plant, with broad cluster of leaves each having border with a purple pinkish color, it also has this color in the middle of each leaf. They are very unique and exotic plants and are widely popular as a houseplant. It offers notable medicinal benefits, particularly in treating respiratory conditions, relaxation and healing properties. It removes indoor air borne pollutants like formaldehyde, CO_2, benzene, lead, trichloroethylene which can be found in paints, furniture, machines and other electrical appliances. Each plant has its individual requirement for sunlight and shade under which it flourishes at its best. To create optimum climatic conditions, selection of the correct percentage of shade level is a crucial factor to enhance plant's productivity to its highest (Gaurav *et al*., 2015). Agricultural crops are often protected by nets from pests, excessive sun radiation and freezing temperatures. Nets are being utilized to modify sunlight in certain ways, enhance the microenvironment and offer physical protection. Color nets are a novel approach to agro technology that combines physical protection with selective solar radiation filtering to enhance desired physiological response. The basis for ornamental crops' use of solar radiation is the selective filtering of light through various colored shade nets with unique optical qualities that alter the natural radiation's quality. Shade nets have a significant impact on shoot elongation, branching, flowering and offer physical protection in addition to optimizing desired physiological responses in ornamental crops (Oren-Shamir *et al*., 2001). Many times, shade nets are utilized to improve the thermal temperature and shield crops from intense sun radiation (Kittas *et al*., 2009). Depending on how much shade is present, the air temperature is lower than the surrounding air temperature. In addition to reducing the amount of light, shade nets can also modify the quality

of light to variable degrees and may also affect other environmental factors (Smith *et al.,* 1984).

Regardless of color, nettings change the microenvironment and lessen radiation that reaches crops. Shade nets can scatter radiation; especially ultraviolet because nets are usually made using ultraviolet-resistant plastic (Wong, 1994). This effect is closely correlated with the shade factor. In light of these facts, the current investigation was carried out to examine the production and caliber of Cordyline under various colour shade nets.

This research focuses on the evaluation of coloured shade nets and nutrient management strategies to enhance the vegetative parameters of *Cordyline terminalis* during rainy season. The selection of appropriate shade nets plays a crucial role in controlling light intensity and quality, thereby influencing plant growth and development. Additionally, the judicious application of nutrients is vital for ensuring adequate nourishment, promoting robust foliage and enhancing the plants overall aesthetic appeal. Foliar spray enables plants to absorb the applied nutrients from the solution through their leaf surface and thus, may result in the economic use of fertilizer (Manasa *et al*., 2015). It is important to highlight that an adequate balance of nutrients, besides being related to high quality flower production, is also intimately linked to the resistance of the plants against pests and diseases (Malavolta, 2006; Zambolim *et al*., 2012). Nitrogen is the nutrient that is absorbed in greater quantity and accumulates in larger amounts in the dry mass of the plants. Potassium is the nutrient required in higher quantity. Potassium is directly related to the maintenance of the osmotic balance in plant cells, the process of the regulation of the gas exchange and transpiration, enzyme activation, protein synthesis, photosynthesis and stress resistance (Benites *et al*., 2010; Marschner, 2012).

The study aims to bridge existing knowledge gaps by investigating the synergistic effects of coloured shade nets and nutrient formulations on the growth, morphology, and physiological characteristics of *Cordyline terminalis*. Understanding how different shade levels and nutrient combinations impact the plants vegetative parameters is essential for horticulturists, landscapers and urban planners seeking sustainable and visually appealing solutions for green spaces in urban environments.

The findings of this research endeavor are anticipated to serve as a valuable resource for horticultural practitioners, landscape designers and researchers fostering the sustainable integration of greenery into urban landscapes and promoting environmental conservation while enhancing the aesthetic appeal of urban spaces.

MATERIALS AND METHODS

Three replications of each color shade net (white and green) with 50% shading intensity and a control group without a shade net were used in this completely randomized design experiment. Soil, FYM, Sand, and Coco-peat were combined in a 1:1:1:1 ratio to create the potting media. The rooted plantlets were transplanted in 4' x 6' polybags that had been filled with potting mixture. After 15 days of their transplantation, the plants were treated with a water-soluble fertilizer, namely NPK 19:19:19 @ 1% (0.25 % per month for 4 months) and 2% (0.25% every two weeks). Plant height, petiole length, internode length, leaf area, chlorophyll content and the number of leaves were among the vegetative characteristics for which data were collected.

RESULTS AND DISCUSSION

A. Plant height (cm)

The data presented in Table 1 for studying the effect of coloured shade nets and nutrients on plant height in *Cordyline terminalis* during rainy season revealed that foliar application of 1% NPK (19:19:19) grown under white shade net significantly enhanced the plant height (38.01) cm and the data stood at par with treatment T_9 (White shade net + NPK 19:19:19 @ 2%). Minimum plant height (24.07cm) was recorded in the treatment T1 i.e., control (Open condition + no fertilizer). Plants grown under either green shade net or white shade net increases the height significantly over the control & among the shade nets white shade net showed good results in enhancing the plant height in *Cordyline terminalis* in rainy season. Gaurav *et al.* (2016) reported that dracaena plants grown under red and white shade-nets exhibited better plant height and leaf area, it might be because both the shade net exhibited higher PAR transmittance and low canopy temperature than other coloured nets. As a result, plant grown under white and red shade net showed good vegetative growth, it was supported with the findings of Nissim-Levi *et al.* (2008) in ornamental pot plants.

B. Petiole length (cm)

From the perusal of the data in Table 1 stated that foliar application of NPK (19:19:19) @ 1% significantly had longer petiole length (12.60) cm when the *Cordyline terminalis* plants grown under white shade net during rainy season and the data remain at par with the plants foliar sprayed with 2% NPK (19:19:19) either grown in white, green or in ambient condition being minimum (8.99) cm in control. Plants grown under ambient condition with or without application of NPK (19:19:19) reduced the petiole length during rainy season. These findings are in line with the result of (Gaurav *et al.,* 2016) in cordyline and (Costa *et al*., 2010) in *Occimum selloi.*

C. Internode length (cm)

Plants were taller under coloured nets due to increase in internode length and not due to increase in number of nodes (leaves). The internode length was found to be longer by (4.81) cm when *Cordyline terminalis* plants fertified with NPK (19:19:19) @ 1 % under white coloured net during rainy season as compared to control as reported in Table 1. In agreement with the present studies, Devkota and Jha (2010) reported longer petiole length and internode length at 50-70% shade level in *Centella asiatica*.

C. Leaf area (cm^2)

Leaf area is a very useful parameter of growth as it interprets the capacity of a crop for producing dry matter in term of the intercepted utilization of radiation and amount of photosynthesis synthesized. Foliar application of NPK (19:19:19) @ 1 % significantly produce larger leaves (73.51) cm^2 presented in table 1 in *Cordyline terminalis* plants grown under white shade net during rainy season. Plants grown under white shade net or in ambient condition with or without application of higher dose of NPK (19:19:19) or without fertilizer reduce the leaf area and data recorded at par with T_3 (White shade net + No fertililizer) and T_6 (white shade net + NPK 19:19:19 @ 1%).

D. Chlorophyll Content

The SPAD reading for chlorophyll content was found to be (56.65) which is significantly high in T_6 (White shade net + NPK 19:19:19 @ 1 %) in *Cordyline terminalis* plants during rainy season as reported in Table 1. Chloroplasts were more numerous and larger in plants grown under shading, while the accumulation of chloroplastic starch grains was greater in plants grown under red shading or in full sunlight (Costa *et al*., 2010). Because of the above factor photosynthetic rates were higher in white shade net. In addition, Rathore *et al*. (1985) found that higher nitrogen and phosphorus fertilization rates improved leaves chlorophyll content of African marigold. Habib (2012) reported that NPK fertilization rates significantly increased chlorophyll a and b contents of fishtail palm.

E. Number of leaves

When plants in *Cordyline terminalis* were grown under a white shade net throughout the rainy season and treated with NPK (19:19:19) at 1%, the maximum number of leaves per plant was measured and the result (27.36) is shown in Table 1. Due to the high quality of light the plants received, this may be explained by the heightened metabolic processes during plant growth, such as high photosynthesis and reduced transpiration.

An increase in all vegetative parameters may be described to the plants receiving the ideal amount of nitrogen, which boosted protein synthesis and as a result, raised meristematic activity, which in turn led to higher plant growth (Arney, 1950; Salvi, 1997; Srinivasa and Reddy 2005; Valsalakumari *et al*., 2001). According to Baboo and Singh (2006), nitrogen is the primary component of chlorophyll and is essential to several physiological processes, including photosynthesis. Because diffuse light may reach the vegetative canopy more easily than direct light and may be changed spectrally, it is more effective for photosynthetic processes. This is why red and white shade nets have improved vegetative growth (Oren-Shamir *et al*., 2001).

Table 1: Effect of coloured shade nets and nutrients on vegetative parameters in *Cordyline terminalis* during rainy season.

Characters / Treatments	Rainy Season					
	Plant height (cm)	**Petiole length (cm)**	**Internode length (cm)**	**Leaf area (cm^2)**	**Chlorophyll Content (SPAD)**	**No. of leaves per plant**
T_1 Control (Open condition + No fertilizer)	24.07	8.99	3.41	36.28	33.73	10.93
T_2 (Green shade net + No fertilizer)	26.88	10.87	3.96	61.18	46.03	20.17
T_3 (White shade net + No fertilizer)	26.9	9.63	3.81	57.59	40.35	19.37
T_4 (Open Condition + NPK 19:19:19 @ 1%)	24.18	11.16	4.09	42.93	38.94	13.50
T_5 (Green shade net + NPK 19:19:19 @ 1%)	26.71	12.21	3.75	66.19	41.21	22.16
T_6 (White shade net + NPK 19:19:19 @ 1%)	**38.01**	**12.60**	**4.81**	**73.51**	**56.65**	**27.36**
T_7 (Open Condition + NPK 19:19:19 @ 2%)	27.03	11.70	3.39	40.61	34.43	14.58
T_8 (Green shade net + NPK 19:19:19 @ 2%)	26.89	12.04	4.41	71.54	51.37	24.02
T_9 (White shade net + NPK 19:19:19 @ 2 %)	36.66	12.18	4.21	71.22	47.11	27.26
SE(m) ±	0.98	0.42	0.18	1.42	1.62	0.77
CD (5%)	2.92	1.25	0.53	4.14	4.82	2.29
CV	5.96	6.46	7.79	8.94	6.48	6.69

CONCLUSIONS

In comparison to green shade net and control, white-colored shade nets with NPK 19:19:19 @ 1% during the rainy season were found to be superior in enhancing the majority of the plant characteristics. Because of their higher plant height, inter-node length, leaf area, chlorophyll content, number of leaves, and other crucial properties, it was determined that they were the best shade nets for commercial growth of *Cordyline*

terminalis. Therefore, for living wall plants and potted plants, white shade net can be suggested as a substitute for the green shade net utilized in commercial cultivation.

FUTURE SCOPE

Research in this area could lead to enhanced cultivation techniques, urban greening, biodiversity conservation, commercial applications and climate change resilience. Further research can explore specific light spectra that promote optimal growth for *Cordyline terminalis*. Understanding the effects of different coloured shade nets on photosynthesis and overall growth can be beneficial. Investigate customized nutrient formulations tailored to the specific needs of *Cordyline terminalis*. This could involve experimenting with different ratios of macro and micronutrients and studying their impact on plant growth. Explore applications of *Cordyline terminalis* in living walls, especially in urban areas where vertical gardening is becoming popular. Research should focus on its ability to purify air, conserve energy and enhance aesthetics.

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Conflict of Interest. None.

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