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Efficacy of Coloured Shade Nets and Nutrients on Vegetative Growth and Development of Indoor and vertical Garden Plant *Chlorophytum laxum* in Rainy Season

Sadhana Swastika[1], Sashikala Beura[1]*, Manas Ranjan Nath[2], Anupama Baliarsingh[3] and Pragnya Paramita Mishra[1]

[1]Department of Floriculture & Landscaping, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar (Odisha), India.
[2]AICRP on Floriculture, Odisha University of Agriculture and Technology, Bhubaneswar (Odisha), India.
[3]Department of Agronomy, Odisha University of Agriculture and Technology, Bhubaneswar (Odisha), India.

(Corresponding author: Sashikala Beura)*
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ABSTRACT: An experiment was carried out at Department of Floriculture in the College of Agriculture, OUAT, Bhubaneswar. This experiment's objective was to investigate the effectiveness of coloured shade nets (green and white) with shading intensity of 50 %, control (no shade net) and nutrients i.e., NPK 19:19:19 @ 1% and 2% on vegetative growth and development of indoor and vertical garden *Chlorophytum laxum.* This plant's performance was researched for 1 year. Vegetative parameters like plant height, plant spread (E-W), plant spread (N-S), leaf thickness, leaf area, chlorophyll content, number of stolons per plant and no. of leaves per plant were recorded superior under green shade net with foliar application of NPK 19:19:19 @ 1% followed by white shade net. Green shade net found to be best in improving plant growth and hence they can be used commercially for improved growth of spider plant.

Keywords: Coloured shade nets, shading intensity, nutrients, *Chlorophytum laxum*, vegetative parameters, spider plant.

INTRODUCTION

Beauty of landscape garden enhances physical and mental health of people. As a result, cultivating potted plants, ornamental plants and plants that purify the air has become increasingly important. These indoor plants can effectively purify the indoor air by decreasing volatile organic compounds such as formaldehyde, benzene, toluene and ethylene. NASA has identified this plant for its capacity to alleviate the effect of formaldehyde, carbon monoxide and benzene from indoor air (Chen *et al*., 2003). 50 indoor plants including money plants, rubber plants, bamboo and palm eliminated formaldehyde, benzene and carbon monoxide from the environment. Ammonia, formaldehyde, xylene and toluene were removed from the environment by peace lily and anthurium. Snake plants, dracaena and gerbera removed trichloroethylene, while spider plants removed xylene and toluene from environment (Beura *et al.*, 2021).

The evergreen perennial herbaceous plant *Chlorophytum laxum*, commonly known as the spider plant or air plane plant is a member of the Asparagaceae family. Due to its simple maintenance requirements and appealing appearance, it is extensively grown as an indoor plant all over the world. Its ornamental appeal is enhanced by the variegated leaves with white strips or borders. It is well renowned for its capacity to filter the air. It is a great option for indoor areas since it can help in removing air borne pollutants like formaldehyde and xylene. For providing an optimum microclimate to the plants shade nets are used. Nets not only decrease light quantity but also alters light quality to a varying extent and also change other environmental conditions (Smith *et al*., 1984). Colour nets represent new agro-technological concept, which not only exhibit special optical properties that allow the control of light, but also have the advantage of influencing the microclimate to which the plant is exposed and offer physical protection against excessive radiation, insect pests and environmental changes (Shahak *et al*., 2004). Application of optimum dose of nutrients is also one of the most important cultural practices that affect growth and development of foliage plants. However, the research on shade nets and nutrients on foliage plants is scanty; henceforth there is need of scientific study on impact of coloured shade nets and nutrients on growth and development of *Chlorophytum laxum* in rainy season.

MATERIALS AND METHODS

The experiment was laid out in a Completely Randomized Design with three replications in each coloured shade nets (green and white) with shading intensity 50% and control (without shade net).The potting media was prepared by mixing 1:1:1:1 ratio of soil, FYM, sand and coco-peat. Polybags measuring 4x 6 inches were filled with the potting mixture. *Chlorophtum laxum* stolons with one or two roots per plant were chosen from mature plants and transplanted into the polybags. After 15 days of transplanting the plants were sprayed with water soluble fertilizer i.e., NPK 19:19:19 @ 1% (0.25 % at monthly intervals for 4 months) and 2% (0.25% at fortnight intervals). Different cultural practices were followed throughout the experiment. The data were recorded on vegetative parameters, viz. plant height, plant spread (E-W), plant spread (N-S), leaf thickness, leaf area, chlorophyll content, no. of stolons per plant and no. of leaves per plant.

RESULTS AND DISCUSSION

A. Plant height (cm)

The results of the study on the impact of coloured shade nets and nutrients on plant height in *Chlrophytum laxum* during rainy season, as shown in Table 1 showed that foliar application of 1% NPK (19:19:19) grown under green shade net significantly increased the plant height (10.23) cm followed by application of 2 % NPK (19:19:19) grown under green shade net or in the treatment T_8 (Green shade net + NPK 19:19:19 @ 2 %). In the treatment T_1- the control, which consisted of an open environment with no fertilizer- the smallest plant height (3.70) cm) was noted. Plants grown under either green shade net or white shade net raised the height significantly over the control. The results corroborated with the findings of Gaurav *et al.* (2016) in cordyline and Udaya (2019) in Multicolour Coleus**.**

B. Plant spread (E-W) (cm)

According to Table 1's results when *Chlorophytum laxum* plants were cultivated beneath a green shade net during rainy season, foliar application of NPK (19:19:19) @ 1% considerably improved the plant spread (20.24) cm in the E-W direction, compared to a minimum (10.75) cm in the control. Plants grown under either white or green shade net significantly increased the plant spread. Plants grown under ambient condition with or without application of NPK (19:19:19) reduced the plant spread in E-W direction during rainy season. This may be due to the increased availability of nutrients by water soluble foliar feeders for rapid absorption of nutrients through leaf stomata by foliar application of (19:19:19 NPK) to growing plants, which may have increased chlorophyll formation, photosynthesis rate, development of dry matter and thus resulted in improved overall plant growth. These finding are in line with those of Khawlhring *et al.* (2019) in *Anthurium andreanum* cv. Evita and El-Sayed *et al.* (2017) in *Hibiscus rosa-sinensis* and Patel *et al.* (2020) in *Coreopsis tinctoria*.

C. Plant spread (N-S) (cm)

Table 1 showed the information on plant spread for the plants cultivated under coloured shade nets. It has been noted that during the rainy season *Chlorophytum laxum* plants fertified with NPK (19:19:19) @ 1 % grew under green shade net significantly increased in the plant spread in N-S direction i.e. (19.83) cm. Minimum plant spread, (9.82) cm was recorded in Treatment T_1 i.e., Control (Open condition + No fertilizer). Plants planted in shade nets fertified with either 1% or 2% NPK (19:19:19) showed mediocre results.

D. Leaf Thickness (mm)

Maximum leaf thickness, (0.56) mm was recorded in those plants fertified with NPK (19:19:19) @ 1 % grown under green shade net during rainy season in *Chlorophytum laxum*. Thinner leaves, (0.35) mm was recorded in the treatment T_1 i.e., control (Open condition + no fertilizer), when the plants were cultured in ambient condition without application of any fertilizer. The plants grown under shade nets produced thicker leaves irrespective of application of NPK being thickest in treatment T_5 (Green shade net + NPK 19:19:19 @ 1 %) as showed in Table 1.

E. Leaf area (cm^2)

Foliar application of NPK (19:19:19) @ 1% significantly produce larger leaves, (21.58) cm^2 in *Chlorophytum laxum* plants grown under green shade net during rainy season, the data stood at par with the application of NPK (19:19:19) @ 1 % either grown under open or white shade net being lowest (16.10) cm^2 in treatment T_1 Control (Open condition + No fertilizer). Plants grown under green 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 as recorded in Table 1.

F. Chlorophyll Content

The SPAD reading for chlorophyll content found to be significantly high (7.27) in T_5 (Green shade net + NPK 19:19:19 @ 1 %) in *Chlorophytum laxum* plants during rainy season, the data stood at par with all the treatments except T_1 Control (Open condition + No fertilizer) and T_7 (Open condition + NPK 19:19:19 @ 2%).as recorded in Table 1.

G. No. of stolons

Maximum no. of stolons per plant (12.77) was recorded in those plants applied with NPK (19:19:19) @ 1% and grown under green shade net during rainy season in *Chlorophytum laxum* as presented in Table 1. Minimum no. of stolons per plant, (2.26) was recorded in the treatment T_1 i.e., control (Open condition + No fertilizer) when the plants were grown in ambient condition without application of any fertilizer.

Table 1: Effect of coloured shade nets and nutrients on vegetative parameters of *Chlorophytum laxum* during rainy season.

Characters / Treatments	Rainy Season							
	Plant height (cm)	Plant Spread (E-W)	Plant spread (N-S)	Leaf thickness (mm	Leaf area (cm^2)	Chlorophyll content (SPAD)	No. of stolons per plant	No. of leaves per plant
T_1 Control (Open condition + No fertilizer)	3.70	10.75	9.82	0.35	16.10	5.98	2.26	13.27
T_2 (Green shade net + No fertilizer)	5.89	16.24	15.60	0.42	16.46	7.17	6.88	20.60
T_3 (White shade net + No fertilizer)	5.26	16.01	14.58	0.37	16.32	6.81	5.69	21.61
T_4 (Open Condition + NPK 19:19:19 @ 1%)	4.17	13.70	12.43	0.39	20.10	6.76	5.39	14.78
T_5 (Green shade net + NPK 19:19:19 @ 1%)	**10.23**	**20.24**	**19.83**	**0.56**	**21.58**	**7.27**	**12.77**	**33.45**
T_6 (White shade net + NPK 19:19:19 @ 1%)	6.80	18.51	17.54	0.52	20.56	6.92	10.49	23.23
T_7 (Open Condition + NPK 19:19:19 @ 2%)	3.94	11.86	11.60	0.40	17.87	6.25	10.57	15.62
T_8 (Green shade net + NPK 19:19:19 @ 2%)	9.39	16.70	15.52	0.52	19.40	6.69	11.42	24.87
T_9 (White shade net + NPK 19:19:19 @ 2 %)	6.30	16.48	15.36	0.46	18.54	6.55	10.4	28.56
SE(m) ±	0.27	0.52	0.57	0.02	1.00	0.25	0.11	1.13
CD (5%)	0.81	1.53	1.71	0.06	2.97	0.74	0.34	3.35
CV	8.43	6.01	7.12	7.33	9.35	6.40	9.23	9.16

H. No. of leaves

From the perusal of the data in Table 2 it has been observed that *Chlorophytum laxum* plants fertified with NPK (19:19:19) @ 1 % grown under green shade net significantly increased the no. of leaves/plant i.e., (33.45) during rainy season. Minimum no. of leaves 13.27 was recorded in treatment T1 i.e., control (open condition + no fertilizer). This may be attributed to the enhanced metabolic activities like high photosynthesis and low transpiration during the plant growth due to the quality of light received by the plants.

This may be attributed to the enhanced metabolic activities like high photosynthesis and low transpiration during the plant growth due to the quality of light received by the plants. Maximum vegetative growth was recorded in plants grown under green shade net followed by white shade net and open condition as green coloured shade net provides favorable condition for cell division thus promotes growth and development of foliage plants. Nitrogen is a chief constituent of protoplasm and chlorophyll resulting higher photosynthetic activity in plants, which enables the plant for quick and better upward growth. Phosphorous also encourages energy metabolism which influence on cell division and root growth. The beneficial role of potassium in catalyzing various metabolic activities and maintenance of osmotic potential in the cellular environment to keep translocation process at desirable rate. This might have played a positive role in development of plant height. These results are in conformity with the findings of Kabir *et al*. (2012); Ali *et al*. (2014); Kumar *et al*. (2015); Anitha and Kannan (2015) in Dendrobium orchid. Increased level of nitrogen and phosphorus dose resulted in increasing the plant height in Dendrobium orchid. Similar variation was observed by Nair and Sujatha (2010). The possible reason for this acceleration might be due to higher photosynthetic activities for production of IAA and cytokinin which leads to higher meristematic activities in plant for production of higher number of shoots. This was in accordance with the reports of Kumar *et al*. (2015). Increase in chlorophyll content was associated with high leaf N%. Similar results were obtained by Shadchina and Dmitrieva (1995) who found a positive correlation between chlorophyll content and N accumulation in leaves. The temperature under different coloured shade-nets varied significantly. It was found to be higher under control as compared to shade net. Reduced air temperature was in agreement with the result of Campanha *et al.* (2005). Temperature reduced by 2-3°C under black shade net and this in turn affects plant processes (Smith *et al*., 1984). Relative humidity (RH) was higher under coloured nets even though temperature was low. It was highest under black shade net followed by green, red and white as compared to control.

CONCLUSIONS

The present investigation has led to certain important points to be stated as valid conclusions for *Chlorophytum laxum* as it performed best in all vegetative parameters in green shade net with the application of NPK 19:9:19 @ 1 % during rainy season. Colored shade netting is a relatively a new tool that can be used for a wide variety of purposes by floriculturists and landscape designer for beautification and amelioration of the indoor

environment. The results will pave the path of the entrepreneurs, researchers and students as well.

FUTURE SCOPE

Coloured shade nets can be tailored to manipulate the spectrum of light reaching the plants, optimizing the photosynthesis process. Research in this area could lead to enhanced growth, improved yield and possibly alternations in plant characteristics. Additionally, understanding the specific light requirements of *Chlorophytum laxum* under different coloured shade nets can open avenues for controlled environment and urban gardening.

Likewise, improving *Chlorophytum laxum* nutrient solutions can result in healthier and more productive plants. The development of specialized nutrient formulations and micronutrients to improve the plants general health, vitality and disease resistance may be the subject of future research.

The integration of both coloured shade nets and customized nutrient solutions could potentially revolutionize the cultivation of *Chlorophytum laxum* making it more efficient, sustainable and adaptable to various environmental conditions. This research could have implications for commercial foliage industry, ornamental plant cultivation and environmental conservation efforts.

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