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Growth performance of ornamental foliage plants under different shade intensity

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Abstract
The field experiment "growth performance of ornamental foliage plants under different shade intensity" was conducted at College of Horticulture, Mulde for successive three years (2020-2023) to optimize the shade net intensities for better growth performance of ornamental plants. The experiment was laid out in Split plot design along with 4 green colour shade net conditions *viz*., 25% Shade net, 50% Shade net, 75% Shade net and Control (main treatments) and 06 woody foliage plants *viz*., Red Acalypha, Green Acalypha, Malphigia, Arelia, Croton and Coleus (sub treatments) and replicated twice. From the investigation it can be concluded that different woody foliage plants showed better overall growth performance under M_2 (50% shade condition) followed by M_1 (25% shade condition). Hence for getting good quality of Red Acalypha, Green Acalypha, Malphigia, Arelia, Croton and Coleus, plant should be cultivated for cut greens commercially under 50% shade net.

Keywords: Growth parameters, Ornamental foliage plants, Shade intensity

Introduction
Plants are autotrophic organisms capable of synthesizing their own food through photosynthesis. Their ecological roles extend beyond food production to regulating atmospheric gases, sequestering carbon dioxide, and releasing life-sustaining oxygen. Urban ecosystems, due to intense anthropogenic activity and unchecked infrastructure development, have witnessed a sharp decline in vegetative cover. This, in turn, has led to environmental challenges such as the urban heat island effect, deteriorating air quality, and loss of biodiversity (Wong *et al*., 2003) [14].

Cut foliage and quality indoor plants have a great opportunity in the local as well as foreign markets and can play a valuable role in the economic upliftment of the farmers (El-Ghait *et al.*, 2012) [3]. The use of these bio-degradable decorative foliage's as fillers in bouquet making has increased substantially from 5% to 20-25% (Bhattacharjee, 2006). In India, commercial production of cut foliage has flourished in recent years because of its huge demand, especially during festivals and annual events. The floricultural sector relies heavily on ornamental foliage plants, which are mostly used as fillers in flower arrangements for adornment. Indoor plants provide arrangements and exhibit a fresh, colorful, and varied feel. In recent years, India has begun the commercial manufacturing of cut foliage plants, which are in high demand on the market. The cut foliage's may be produced all year round with little upkeep and expenditure. In general, plants with beautiful leaves thrive in partial shade and produce foliage all year round. Some decorative, vegetable, and even fruit crops have previously been tested using the colored shade netting method of covered agriculture. Regardless of colour, providing shade nets will lower radiation that reaches the crops below and is directly correlated to the shade factor and change the micro-environment. Due to easy monitoring, consistent seedling growth, a lower incidence of pests and diseases, and a lower mortality rate, these nurseries are raised in protected structures (Patil *et al.*, 2017) [6].

Red Acalypha, Green Acalypha, Malphigia, Arelia, Croton and Coleus are important woody ornamental plants in the world trade and used worldwide for their beautiful foliage's. High grade quality foliage and healthy ornamental plants fetch more price and demand in the market. Today's lucrative business is ornamental plant nurseries, which include a wide variety of nurseries based on wholesale or retail, indoor/shade-loving plants, tissue culture plants, commercial flowering plants, shrub, climber, and tree seedlings for landscaping,

annual plants, bulbous flowers, etc. Nurseries should be able to produce and deliver the needed quantity of seedlings at the appropriate time in the event of a sudden surge or drop in demand (Ashoka *et al.,* 2019) [2]. These nurseries are doing well across the nation. Efficient and affordable shade structures facilitate the nurserymen in production of quality planting material so that they can get more profit. Use of different coloured shade nets improves the quality and production of cut greens and indoor plants.

During the last decades, due to increased air temperature and intensity of solar radiation caused by climate changes, an increasing area of crops is being grown under shading materials of various types. Nets are commonly used in agricultural crops for specific modification of sunlight, improving microenvironment, and providing physical protection. They not only decrease light quantity but also alters light quality to a varying extent and also change other environmental conditions (Smith *et al*., 11) [9]. Cut greens grown under different shade-net gave better performance in terms of plant height, number of leaves, number of branches, leaf area, number of roots, etc. compared to control. Nettings, regardless of colour, reduce radiation reaching crops underneath which is directly proportional to the shade factor and modify microenvironment. Keeping these facts in view the present study was undertaken to observe the production and quality of dracaena under different colour shade-nets.

Cut greens are an important component of the floricultural industry and are largely used for decoration as a-filler in floral compositions. They provide freshness, colour and variety to various decorations, arrangements and bouquets. Foliage plants are one of the important cut greens and are used widely for its beautiful foliage. Nets are commonly used in agricultural crops for specific modification of sunlight, improving microenvironment, and providing physical protection. They not only decrease light quantity but also alters light quality to a varying extent and also change another environment. Nets have three major uses in horticulture (i) shading, for protection from too much solar radiation; (ii) protection from environmental hazards such as strong winds, hail and sand storms; (iii) protection from flying pests like birds, fruit bats, etc. Study the effect of different shade levels on the growth and biomass production potential of Cactus (*Opuntia ficus* (L.) Mill.) under the arid Kachchh, Gujarat. Cactus in pots were grown for twelve months under 25, 50 and 75% shade; along with under full sun control. (Abhay K. G.*et al.,* 2015) [1]

Shade net has been found to improve vegetative growth, yield, vase life and quality (Stamps 1997) [10] of cut foliage. Shade level significantly affected plant response; the shading improved plant characters like height, number of leaves, leaf area, and overall plant weight. However, plant survival decreases at under high shade level (75%), mainly due to rotting. The plants grown in 25% and 50% shade levels produced the highest leaf area, no. of leaves and biomass than plants subjected to 75% shade and control. Plants grown under 75% shade level were taller, due to more longitudinal and less wide leaves (cladodes) along with more root length. Overall, up to 50% shading was found best for horti-based or agroforestry-based cactus pear cultivation or intercropping (Dev *et al*., 2018) [7].

By keeping all these views in front, experiment entitled "growth performance of ornamental foliage plants under different shade intensity" carried out with following objectives.

a. To find out the effect of shade conditions on sprouting.
b. To find out the effect of shade conditions on growth performance of ornamental foliage plants.
c. To find out optimum shade conditions for foliage plants.

Material and Methods

The field experiment was conducted at College of Horticulture, Mulde for successive three years (2020-2023) and laid out in Split plot design along with 4 green colour shade net conditions (main treatments) and 06 woody foliage plants (sub treatments) and replicated twice.

The object of field experiment was to optimize the shade net intensities for better growth performance of ornamental plants. The observations on sprouting and growth parameters were recorded. The experiment was carried out during Year 2020-21, 2021-22, 20022-23. The experiment carried out in Split Plot Design with two replications. Main plot treatments consist of four different Shade conditions *viz*., 25% Shade net, 50% Shade net, 75% Shade net and Control, while Sub plot Treatments consists of six different Foliage plants *viz*., Red Acalypha, Green Acalypha, Malphigia, Arelia, Croton and Coleus. There were 24 treatment combinations.

Results and Discussion

Days required for sprouting

It is revealed from Table 1 that days required for sprouting of different woody foliage plants was varied significantly among different shade conditions. In case of shade conditions significantly the lowest days required for sprouting (45.50 days) was noticed in the M_1 (25% shade net). Further, the highest days required for sprouting observed in M_4- Control (71.06 days,). Thus, the days for sprouting increased with increase in shade conditions. Among in different woody foliage plants, significantly the lowest days required for sprouting (39.42 days) was noticed in P_2 (green acalypha), while the highest days required for sprouting (96.17 days) observed in P_5 (croton). In case of interaction effect significantly lowest days required for sprouting (22.17 days) was recorded with coleus under 25%. Whereas, significantly highest days required for sprouting (131.83 days) was recorded with croton under open condition. Similar results were found by Dev *et al.,* (2018) [7].

Plant height

It is revealed from Table 2 that plant height of different woody foliage plants was varied significantly among different shade conditions. In case of shade conditions significantly the highest plant height was observed in M_2 - 50% (62.94 cm) shade net. Further, Lowest plant height observed in M_4- (52.25 cm) open condition. Among different woody foliage plants, significantly the highest height (68.39 cm) was noticed in P_1 (red acalypha), while the lowest height observed in P_3 (malphigia). In case of interaction effect significantly highest plant height (74.36 cm) was recorded with red acalypha under 50% shade condition it was at par with green acalypha under 50% shade condition red acalypha under 25% shade condition. Whereas, significantly lowest plant height (31.71 cm) was recorded with croton under open condition. Similar results were also reported by Yasoda P. G. *C et al*., (2018) [13], Dev *et al.,* (2018) [7]

Plant spread

It is observed from Table 3 that plant spread of different woody foliage plants was varied significantly among different shade conditions. In case of shade conditions significantly the highest plant spread was observed in M_2 - 50% (72.11 cm) shade condition. Lowest plant spread

observed in M_4- (46.55 cm) open condition and was superior over M_3 (75%) shade condition. Among in different woody foliage plants, significantly the highest plant spread (96.60 cm) was noticed in P_5 (croton), while the lowest plant spread observed in P_2 (green acalypha). In case of interaction effect significantly highest plant spread (132.73 cm) was recorded with croton under 50% shade condition. Whereas, significantly lowest plant spread (20.41 cm) was recorded with malphigia under 75% shade condition.

Number of leaves

It is observed from Table 4 that number of leaves of different woody foliage plants was varied significantly among different shade conditions. In case of shade conditions significantly the highest number of leaves was observed in M_2 - 50% (8.79) shade condition. Lowest number of leaves observed in M_4- (5.23) open condition and was superior over M_3 (75%) shade condition. Among in different woody foliage plants, significantly the highest number of leaves (9.68) was noticed in P_1 (red acalypha), while the lowest number of leaves observed in P_3 (malphigia). In case of interaction effect significantly highest number of leaves (12.80) was recorded with red acalypha under 50% shade condition and it was at par with M_1P_1. Whereas, significantly lowest number of leaves (1.46) was recorded with malphigia under open condition which was at par with malphigia under 50% shade condition Same results also reported by Swagatika *et al,*. (2006), Elad *et al.*, (2007) [4], Vethamoni and Natarajan (2008) [12], Haque *et al.*, (2009) [5] and Rajasekar *et al.*, (2013) [8], Yasoda P. G. *C et al*., (2018) [13], Dev *et al.*, (2018) [7]

Number of branches

It is revealed from Table 5 that number of branches of different woody foliage plants were varied significantly among different shade conditions. In case of shade conditions significantly the highest number of branches observed in M_2 - 50% (7.52) shade condition and was superior over all. Further, Lowest number of branches observed in M_4- (4.47) open condition. Among as in different woody foliage plants, significantly the highest number of branches (6.97) was noticed in P_1 (red acalypha) and it was at par with P_6, while the lowest number of branches observed in P_3 (mlphigia). In case of interaction effect significantly highest number of branches (8.25) was recorded with croton under 50% shade condition which was at par with M_2P_1. Whereas, significantly lowest number of branches (3.24) was recorded with malphigia under 75% shade condition which was at par with M_4P_3 and M_4P_5.

Leaf area (cm^2)

It is observed from Table 6 that leaf area of different woody foliage plants was varied significantly among different shade conditions. In case of shade conditions significantly the highest leaf area was observed in M_2 - 50% (54.30 cm^2) shade condition. Lowest leaf area observed in M_4- (21.91 cm^2) open condition. Among in different woody foliage plants, significantly the highest leaf area (55.86 cm^2) was noticed in P_1 (red acalypha), while the lowest leaf area observed in P_3 (malphigia). In case of interaction effect significantly highest leaf area (101.89 cm^2) was recorded with croton under 50% shade condition. Whereas, significantly lowest leaf area (2.02 cm^2) was recorded with malphigia under open condition and it was at par with M_3P_3, M_2P_3 and M_1P_3. Same results also reported by Zhao *et al.* (2012) [15]

Survival (%)

It is noticed from Table 7 that survival (%) of different woody foliage plants were varied significantly among different shade conditions. In case of shade conditions significantly the highest survival was observed in M_2 - 50% (97.92 %) shade intensities and was superior over all. Lowest survival observed in M_4- (81.17%) open condition. Among in different woody foliage plants significantly the highest survival (91.63 %) was noticed in P_1 (red acalypha) it was at par with P_6. while the lowest survival observed in P_2 (green acalypha) it was at par with P_4, P_3 and P_5. In case of interaction effect non significantly maximum survival % (99 %) was recorded with arelia, croton and coleus under 50% shade condition. Whereas, significantly minimum survival % (82%) was recorded with green acalypha under open condition it was at par with red acalypha under open condition.

Comparative performance

It is observed from Table 8 that comparative performance of different woody foliage plants was varied among different shade conditions. The highest ranking was observed in M_2 - 50% (1.68) shade condition followed by M_1 and M_3. The lowest ranking was observed in M_4- (3.67) i.e. open condition.

Table1: Effect of different shade conditions on days required for sprouting in woody foliage plants

Treat	Days required for sprouting																			
Orn. Plnts	Year 2020-21					Year 2021-22					Year 2022-23					Pooled				
	Shade condition					Shade condition					Shade condition					Shade condition				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
P_1	42.00	53.00	54.50	73.00	55.63	52.50	49.50	57.50	72.50	58.00	50.50	49.50	54.00	71.50	56.38	48.33	50.67	55.33	72.33	56.67
P_2	28.00	31.50	48.50	49.00	39.25	30.50	27.50	52.00	51.00	40.25	31.50	33.00	48.00	42.50	38.75	30.00	30.67	49.50	47.50	39.42
P_3	40.50	43.50	27.50	78.00	47.38	40.50	41.00	28.50	75.50	46.38	41.50	43.00	27.50	63.50	43.88	40.83	42.50	27.83	72.33	45.88
P_4	47.00	51.50	47.50	55.50	50.38	44.50	57.00	46.00	59.00	51.63	40.00	51.00	45.50	53.50	47.50	43.83	53.17	46.33	56.00	49.83
P_5	89.00	100.00	68.00	134.00	97.75	87.50	93.50	67.00	132.00	95.00	87.00	100.00	66.50	129.50	95.75	87.83	97.83	67.17	131.83	96.17
P_6	21.00	24.00	84.50	48.50	44.50	23.00	27.00	72.50	43.50	41.50	22.50	23.50	82.50	47.00	43.88	22.17	24.83	79.83	46.33	43.29
Mean	44.58	50.58	55.08	73.00		46.42	49.25	53.92	72.25		45.50	50.00	54.00	67.92		45.50	49.94	54.33	71.06	
	M	P	MXP	M	P	MXP	M	P	MXP	M	P	M×P								
F test	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG								
SEm (±)	1.10	0.89	1.77	0.92	0.94	1.89	1.35	1.37	2.75	1.01	0.93	1.85								
CD @ 5%	3.30	2.67	5.31	2.76	2.82	5.67	4.05	4.11	8.25	3.03	2.79	5.55								

Shade conditions:
M_1 - 25% shade net, M_2 - 50% shade net,
M_3 - 75% shade net, M_4 - Control

Ornamental plants:
P_1- Red Acalypha P_2- Green Acalypha
P_3- Malphigia P_4- Arelia
P_5- Croton P_6- Coleus

Table 2: Effect of different Shade condition on plant height (cm) in woody foliage plants

Treat	Plant height (cm)																			
Orn. Plnts	Year 2020-21					Year 2021-22					Year 2022-23					Pooled				
	Shade condition					Shade condition					Shade condition					Shade condition				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
P_1	71.32	72.93	61.33	67.01	68.14	68.01	73.35	63.03	63.81	67.05	76.30	76.80	63.03	63.81	69.98	71.88	74.36	62.46	64.88	68.39
P_2	71.79	70.83	58.55	65.02	66.54	70.91	72.20	60.89	65.40	67.35	63.10	72.20	60.89	67.59	65.94	68.60	71.74	60.11	66.00	66.61
P_3	34.23	36.74	34.04	32.42	34.36	36.83	48.20	32.99	27.83	36.46	36.83	48.20	28.10	27.83	35.24	35.96	44.38	31.71	29.36	35.35
P_4	48.15	50.88	43.01	42.55	46.15	49.69	51.10	39.50	41.59	45.47	50.71	53.54	42.11	46.75	48.27	49.51	51.84	41.54	43.63	46.63
P_5	60.75	66.50	61.88	51.76	60.22	67.51	63.40	62.80	52.50	61.55	67.51	65.77	66.33	49.34	62.24	65.25	65.22	63.67	51.20	61.34
P_6	68.17	69.24	63.65	59.96	65.25	68.83	70.10	69.60	56.72	66.31	71.68	70.91	69.60	58.56	67.69	69.56	70.08	67.62	58.41	66.42
Mean	59.07	61.18	53.74	53.12		60.29	63.06	54.80	51.31		61.02	64.57	55.01	52.31		60.13	62.94	54.52	52.25	
	M	P	MXP			M	P	MXP			M	P	MXP			M	P	M×P		
F test	SIG	SIG	SIG			SIG	SIG	SIG			SIG	SIG	SIG			SIG	SIG	SIG		
SEm (±)	0.39	0.51	1.03			0.46	0.75	1.50			1.11	0.69	1.38			0.44	0.45	0.90		
CD @ 5%	1.17	1.53	3.09			1.38	2.25	4.50			3.33	2.07	4.14			1.32	1.35	2.70		

Shade conditions:
M_1 - 25% shade net, M_2 - 50% shade net,
M_3 - 75% shade net, M_4 - Control

Ornamental plants:
P_1- Red Acalypha P_2- Green Acalypha
P_3- Malphigia P_4- Arelia
P_5- Croton P_6- Coleus

Table 3: Effect of different shade conditions on plant spread (cm) in woody foliage plants

Treat	Plant spread (cm)																			
Orn. Plnts	Year 2020-21					Year 2021-22					Year 2022-23					Pooled				
	Shade condition					Shade condition					Shade condition					Shade condition				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
P_1	53.13	73.51	54.95	52.97	58.64	51.92	69.51	53.80	52.60	56.96	59.73	71.89	54.68	50.65	59.23	54.92	71.64	54.48	52.07	58.28
P_2	31.96	49.29	48.90	28.40	39.64	30.59	46.65	48.00	26.50	37.93	29.67	48.03	50.13	27.31	38.78	30.74	47.99	49.01	27.40	38.78
P_3	43.81	78.34	27.95	40.58	47.67	42.19	74.50	21.65	41.50	44.96	45.41	77.41	11.65	42.13	44.15	43.80	76.75	20.41	41.40	45.59
P_4	51.94	55.78	47.86	47.16	50.68	53.65	52.15	46.15	47.86	49.95	52.75	54.42	47.93	50.20	51.32	52.78	54.11	47.31	48.41	50.65
P_5	100.47	134.54	68.43	89.35	98.20	99.75	131.15	67.42	87.84	96.54	95.88	132.51	68.42	83.49	95.07	98.70	132.73	68.09	86.89	96.60
P_6	24.43	48.77	84.87	21.47	44.88	21.50	49.80	82.03	22.00	43.83	23.08	49.85	84.12	25.84	45.72	23.00	49.47	83.67	23.10	44.81
Mean	50.95	73.37	55.49	46.65		49.93	70.63	53.17	46.38		51.08	72.35	52.82	46.60		50.66	72.11	53.83	46.55	
	M	P	MXP			M	P	MXP			M	P	MXP			M	P	M×P		
F test	SIG	SIG	SIG			SIG	SIG	SIG			SIG	SIG	SIG			SIG	SIG	SIG		
SEm (±)	1.02	0.86	1.72			0.40	0.63	1.26			0.52	0.70	1.40			0.62	0.56	1.11		
CD @ 5%	3.06	2.58	5.16			1.20	1.89	3.78			1.56	2.10	4.20			1.86	1.68	3.33		

Shade conditions:
M_1 - 25% shade net, M_2 - 50% shade net,
M_3 - 75% shade net, M_4 - Control

Ornamental plants:
P_1- Red Acalypha P_2- Green Acalypha
P_3- Malphigia P_4- Arelia
P_5- Croton P_6- Coleus

Table 4: Effect of different shade conditions on number of leaves in woody foliage plants

Treat	Number of leaves																			
Orn. Plnts	Year 2020-21					Year 2021-22					Year 2022-23					Pooled				
	Shade condition					Shade condition					Shade condition					Shade condition				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
P_1	11.03	12.56	7.46	5.12	9.04	10.15	12.85	7.45	4.82	8.81	14.97	12.98	10.06	6.68	11.17	12.05	12.80	8.32	5.54	9.68
P_2	8.16	6.36	8.69	9.55	8.19	7.77	7.77	7.01	9.32	7.96	13.05	8.53	8.41	9.51	9.87	9.66	7.55	8.03	9.46	8.67
P_3	3.97	7.04	1.34	1.19	3.39	1.92	8.59	0.93	1.13	3.14	5.10	7.34	2.52	2.07	4.25	3.66	7.65	1.60	1.46	3.59
P_4	6.74	5.88	4.46	4.73	5.45	6.50	5.61	3.89	3.93	4.98	5.30	9.29	4.88	4.91	6.09	6.18	6.93	4.41	4.52	5.51
P_5	5.43	7.19	5.72	3.89	5.56	5.93	7.68	6.07	4.56	6.06	3.55	7.31	5.31	3.36	4.88	4.97	7.39	5.70	3.94	5.50
P_6	7.56	10.04	9.04	7.45	8.52	8.34	11.45	9.56	6.00	8.83	6.02	9.74	8.70	5.90	7.59	7.30	10.41	9.10	6.45	8.31
Mean	7.15	8.18	6.12	5.32		6.77	8.99	5.82	4.96		8.00	9.20	6.64	5.40		7.30	8.79	6.19	5.23	
	M	P	MXP			M	P	MXP			M	P	MXP			M	P	M×P		
F test	SIG	SIG	SIG			SIG	SIG	SIG			SIG	SIG	SIG			SIG	SIG	SIG		
SEm (±)	0.23	0.38	0.76			0.13	0.23	0.45			0.29	0.38	0.76			0.16	0.27	0.53		
CD @ 5%	0.69	1.14	2.28			0.39	0.69	1.35			0.87	1.14	2.28			0.48	0.81	1.59		

Shade conditions:
M_1 - 25% shade net, M_2 - 50% shade net,
M_3 - 75% shade net, M_4 - Control

Ornamental plants:
P_1- Red Acalypha P_2- Green Acalypha
P_3- Malphigia P_4- Arelia
P_5- Croton P_6- Coleus

Table 5: Effect of different shade condition on number of branches developed in woody foliage plants

Treat	Number of branches																			
Orn. Plnts	Year 2020-21					Year 2021-22					Year 2022-23					Pooled				
	Shade condition					Shade condition					Shade condition					Shade condition				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
P_1	9.14	6.50	4.60	7.26	6.87	7.51	8.07	5.89	4.13	6.40	6.51	9.55	10.11	4.40	7.64	7.72	8.04	6.87	5.26	6.97
P_2	5.80	8.21	5.40	4.70	6.03	5.62	7.35	7.20	4.52	6.17	4.91	6.55	6.65	4.93	5.76	5.44	7.37	6.42	4.71	5.99
P_3	5.40	6.30	5.00	3.50	5.05	3.87	6.26	5.02	2.93	4.52	6.41	10.16	3.94	3.30	5.95	5.23	7.57	4.65	3.24	5.17
P_4	5.50	5.60	7.12	3.20	5.35	5.53	6.90	4.14	4.42	5.25	9.47	8.39	6.57	3.54	6.99	6.83	6.96	5.94	3.72	5.86
P_5	4.90	5.60	4.80	3.70	4.75	5.70	9.93	5.32	3.17	6.03	5.88	9.21	4.20	4.14	5.86	5.49	8.25	4.77	3.67	5.54
P_6	5.10	6.10	5.20	4.80	5.30	9.39	6.56	5.78	4.13	6.46	8.81	8.22	6.99	9.73	8.44	7.77	6.96	5.99	6.22	6.73
Mean	5.97	6.39	5.35	4.53		6.27	7.51	5.56	3.88		7.00	8.68	6.41	5.01		6.41	7.52	5.77	4.47	
	M	P	MXP	M	P	MXP	M	P	MXP	M	P	M×P								
F test	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG								
SEm (±)	0.14	0.15	0.29	0.18	0.22	0.44	0.07	0.18	0.36	0.07	0.11	0.22								
CD @ 5%	0.42	0.45	0.87	0.54	0.66	1.32	0.21	0.54	1.08	0.14	0.33	0.66								

Shade conditions:
M_1 - 25% shade net, M_2 - 50% shade net,
M_3 - 75% shade net, M_4 - Control

Ornamental plants:
P_1- Red Acalypha P_2- Green Acalypha
P_3- Malphigia P_4- Arelia
P_5- Croton P_6- Coleus

Table 6: Effect of different shade conditions on leaf area (cm^2) in woody foliage plants (at the end of one year)

Treat	Leaf area (cm^2)																			
Orn. Plnts	Year 2020-21					Year 2021-22					Year 2022-23					Pooled				
	Shade condition					Shade condition					Shade condition					Shade condition				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
P_1	34.12	66.97	66.04	40.98	52.03	47.68	69.09	70.83	29.12	54.18	62.55	66.51	87.23	29.19	61.37	48.12	67.52	74.70	33.09	55.86
P_2	24.99	38.69	60.71	22.85	36.81	26.57	40.69	59.57	23.95	37.70	26.40	44.88	59.84	24.30	38.85	25.99	41.42	60.04	23.70	37.79
P_3	2.74	2.95	2.38	1.93	2.50	2.09	2.93	2.24	2.05	2.33	2.34	2.92	2.44	2.07	2.44	2.39	2.93	2.35	2.02	2.42
P_4	27.41	30.21	35.05	17.15	27.45	5.48	32.21	35.05	20.38	23.28	5.36	32.30	35.26	37.27	27.55	12.75	31.57	35.12	24.93	26.09
P_5	17.80	99.91	65.58	29.44	53.18	36.99	101.91	60.38	10.90	52.54	36.88	103.86	50.46	11.12	50.58	30.55	101.89	58.80	17.15	52.10
P_6	46.20	79.06	36.67	21.95	45.97	26.42	81.06	27.24	34.82	42.38	26.42	81.28	41.93	34.92	46.13	33.01	80.46	35.28	30.56	44.83
Mean	25.54	52.96	44.41	22.38		24.20	54.65	42.55	20.20		26.65	55.29	46.19	23.14		25.47	54.30	44.38	21.91	
	M	P	MXP	M	P	MXP	M	P	MXP	M	P	M×P								
F test	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG	SIG								
SEm (±)	0.48	0.59	1.17	0.40	0.99	1.97	1.52	1.96	3.93	0.41	0.89	1.78								
CD @ 5%	1.44	1.77	3.51	1.20	2.97	5.91	4.56	5.88	11.79	1.23	2.67	5.34								

Shade conditions:
M_1 - 25% shade net, M_2 - 50% shade net,
M_3 - 75% shade net, M_4 - Control

Ornamental plants:
P_1- Red Acalypha P_2- Green Acalypha
P_3- Malphigia P_4- Arelia
P_5- Croton P_6- Coleus

Table 7: Effect of different shade conditions on survival (%) in woody foliage plants (at the end of one year)

Treat	Survival (%)																			
Orn. Plnts	Year 2020-21					Year 2021-22					Year 2022-23					Pooled				
	Shade condition					Shade condition					Shade condition					Shade condition				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
P_1	93.00	99.50	85.50	82.50	90.13	98.50	97.50	86.00	82.50	91.13	99.50	100.00	92.50	82.50	93.63	97.00	99.00	88.00	82.50	91.63
P_2	89.00	99.00	83.50	82.00	88.38	88.00	98.00	82.50	69.00	84.38	90.00	97.50	85.50	83.50	89.13	89.00	98.17	83.83	78.17	87.29
P_3	87.00	98.50	83.50	76.00	86.25	87.50	98.00	84.00	87.50	89.25	86.00	96.00	84.00	87.00	88.25	86.83	97.50	83.83	83.50	87.92
P_4	91.00	99.00	85.00	76.00	87.75	91.00	97.50	82.50	83.50	88.63	92.00	95.00	83.00	76.00	86.50	91.33	97.17	83.50	78.50	87.63
P_5	90.00	97.50	86.50	81.50	88.88	88.00	99.00	84.50	77.50	87.25	91.00	98.50	86.00	86.00	90.38	89.67	98.33	85.67	81.67	88.83
P_6	91.00	100.00	86.50	83.00	90.13	93.50	97.50	85.50	87.50	91.00	94.00	94.50	88.00	77.50	88.50	92.83	97.33	86.67	82.67	89.88
Mean	90.17	98.92	85.08	80.17		91.08	97.92	84.17	81.25		92.08	96.92	86.50	82.08		91.11	97.92	85.25	81.17	
	M	P	MXP	M	P	MXP	M	P	MXP	M	P	M×P								
F test	SIG	SIG	NS	SIG	N S	NS	SIG	SIG	SIG	SIG	SIG	NS								
SEm (±)	0.76	0.73	1.47	0.64	1.81	3.62	0.39	0.84	1.67	0.40	0.67	1.33								
CD @ 5%	2.28	2.19	4.41	1.92	5.43	10.86	1.17	2.52	5.01	1.20	2.01	3.99								

Shade conditions:
M_1 - 25% shade net, M_2 - 50% shade net,
M_3 - 75% shade net, M_4 - Control

Ornamental plants:
P_1- Red Acalypha P_2- Green Acalypha
P_3- Malphigia P_4- Arelia
P_5- Croton P_6- Coleus

Table 8: Comparative performance of different woody foliage plants under different shade conditions

Sr. no.	Sprouting Percentage				Height of plant				Spread of plant				Leaf area				Total
	M_1	M_2	M_3	M_4	M_1	M_2	M_3	M_4	M_1	M_2	M_3	M_4	M_1	M_2	M_3	M_4	
1	1	2	3	4	2	1	4	3	2	1	3	4	3	2	1	4	50
2	1	2	3	4	2	1	4	3	3	2	1	4	3	2	1	4	50
3	1	3	2	2	2	1	3	4	2	1	4	3	3	1	2	4	50
4	1	3	2	4	2	1	4	3	2	1	4	3	4	2	1	3	50
5	2	3	1	4	2	1	3	4	2	1	4	3	3	1	2	4	50
6	1	2	3	4	2	1	3	4	4	1	2	3	3	1	2	4	50
Total	07	15	14	24	12	06	21	21	15	07	18	20	19	09	09	23	
Average	1.17	2.50	2.33	4.00	2.00	1.00	3.50	3.50	2.50	1.70	3.00	3.33	3.16	1.50	1.50	3.83	

Shade conditions:	Ornamental plants:		
M_1 - 25% shade net, M_2 - 50% shade net, M_3 - 75% shade net, M_4 - Control	P_1- Red Acalypha P_2- Green Acalypha	P_3- Malphigia P_4- Arelia	P_5- Croton P_6- Coleus

Table 9: Average light intensity from during the Experimental period

Treatment	Morning light intensity (Lux)	Afternoon light intensity (Lux)	Evening light intensity (Lux)	Mean (Day)
Control	5531	122207	14784	47507
25% shade	4975	83464	8159	32199
50% shade	3806	58750	7447	23334
75% shade	3105	19637	4870	9204

M_1= 8.83 / 4= 2.20 **M_2**=6.7/ 4= 1.68 **M_3**=10.33 /4=2.58 **M_4**= 14.66/5=3.67

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