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Original Research Paper

Influence of potting medium, pot type and growing structure on vertical farming of *Dendrobium* orchid cv. Emma White

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ABSTRACT

Vertical farming is emerging as a sustainable and innovative approach for cultivating high-value crops like *Dendrobium orchids.* The present study was conducted to evaluate the influence of potting medium, pot type and growing structure on growth and flowering of *Dendrobium* cv. Emma White, during 2022-2024. Plants cultivated on vertical frames with potting medium comprising coconut husk, charcoal and tile bits (1:1:1 v/v) in netted pots exhibited the highest pseudo bulb count (4.40), pseudo bulb length (23.35 cm) and internodal length (5.25 cm). However, plants grown in charcoal medium in netted pots on vertical frames recorded maximum number (5.18), length (13.78 cm), width (4.94 cm) and area (55.99 cm^2) of leaf as well as enhanced flowering attributes, such as the earliest spike initiation (175.33 days), maximum spikes $plant^{-1}$ (8.88), florets $spike^{-1}$ (7.67), spike length (49.38 cm), floret diameter (6.30 cm), spike longevity on plant (62.33 days) and vase life (42.00 days). In contrast, plants cultivated on horizontal benches in 6-inch pots using tile bit and potting medium exhibited the lowest vegetative and flowering performance. Pearson correlation results indicated positive correlation of incident PAR (79.30%) with spike production. The findings underscore that orchid cultivation in charcoal medium in netted pots on vertical frames registered higher production of flower spikes with a favourable cost-benefit ratio of 3.77. Vertical farming of *Dendrobium* orchids can thus ensure higher productivity and enhanced income from unit area compared to conventional horizontal farming.

Keywords: *Dendrobium*, potting medium, pot type, vertical frames

INTRODUCTION

Dendrobium, an epiphytic orchid, is the second-largest genus in the family Orchidaceae. Orchids are high value crops, that hold a prominent position in the global cut flower and potted plant trade. Recent market analyses estimate the global orchid market's value at approximately USD 1.05 billion in 2024, projected to reach USD 1.76 billion by 2033 (Econ Market Research, 2024). In spite of conducive agro-climatic conditions prevailing in India for orchids, the country has not made a mark in the global trade. India imports orchids from the countries like Thailand followed by the Netherlands, New Zealand and China (De, 2020).

As urbanization constrains available cultivable land, vertical growing systems have emerged as an efficient solution accommodating more plants per unit area resulting in higher productivity and enhanced income for the growers. Despite its potential, vertical farming of orchids in India remains under-researched, with a knowledge gap in cultural aspects, particularly regarding the container types, potting medium and intercultural operation protocols. Conventional cultivation, typically involving pot culture, cultivation on beds, on horizontal benches, leaves a significant amount of vertical space above and below unused and demands extensive use of arable land which is a limitation. Studies on vertical orchid farming is needed to evaluate productivity, quality and economic viability compared to traditional methods (Nair et al., 2023). The present study focuses on identification of optimal potting medium, pot type and suitable structure for cultivating *Dendrobium* cv. Emma White, aiming to establish a cost-effective approach for higher quality production of cut flowers of *Dendrobium*.

MATERIALS AND METHODS

This study was conducted to evaluate the effect of potting medium, pot type and growing structure on the growth, flowering parameters and economic feasibility of vertical farming of *Dendrobium* cv. Emma White, during 2022 to 2024 at the ICAR-Indian Institute of Horticultural Research, Hesarghatta, Bengaluru, Karnataka, geographically located at 13° 58' N

latitude and 78° 29' E longitude, at an elevation of 890 m above mean sea level with the temperature ranging from 15° to 30°C and relative humidity between 50% and 80% (Fig. 1 & 2). The experiment was designed as a factorial completely randomized design with three replications, ten plants per replication, twenty-four treatment combinations. The treatment comprises three factors *viz*., factor A: potting medium (M_1-coconut husk, M_2-charcoal, M_3-tile bits and M_4-mixed medium of coconut husk, charcoal and tile bits in 1:1:1 v/v, factor B: pot type (P_1-4-inch plastic pots, P_2-6-inch plastic pots and P_3-netted pots) and factor C: growing structures (B_1-horizontal benches and B_2-vertical frames). Coconut husk and tercotta tile bits were manually cut into uniform pieces of approximately 2–3 cm whereas, charcoal used was of hardwood origin, broken into granular pieces ranging from 1–2 cm. Black colur plastic pots of 4 inch and 6 inch and

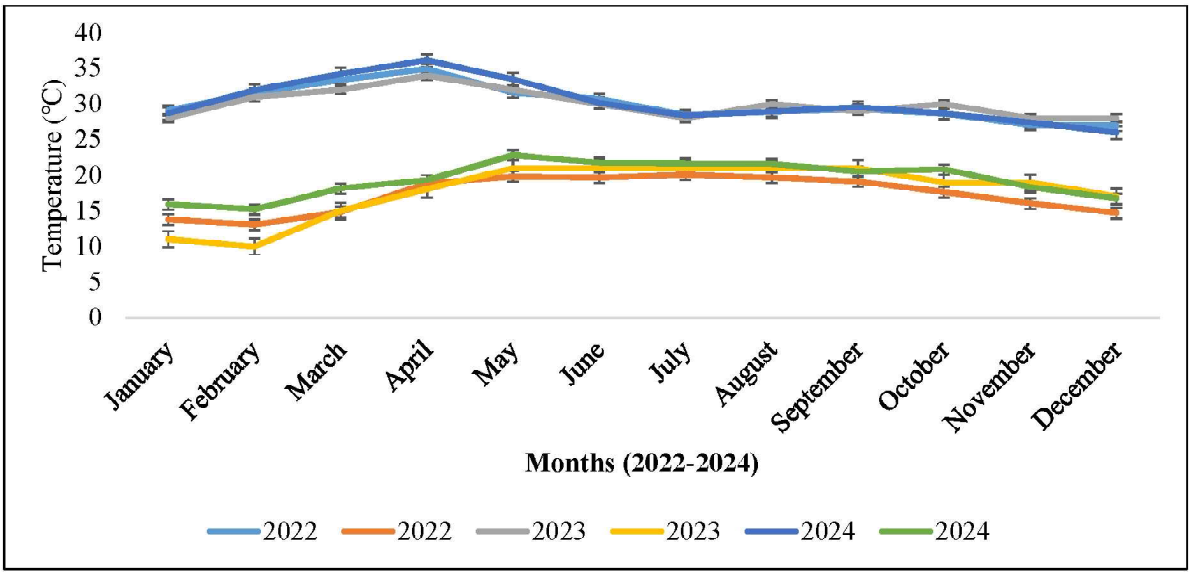

Fig. 1a : Temperature (°C) recorded during 2022-2024

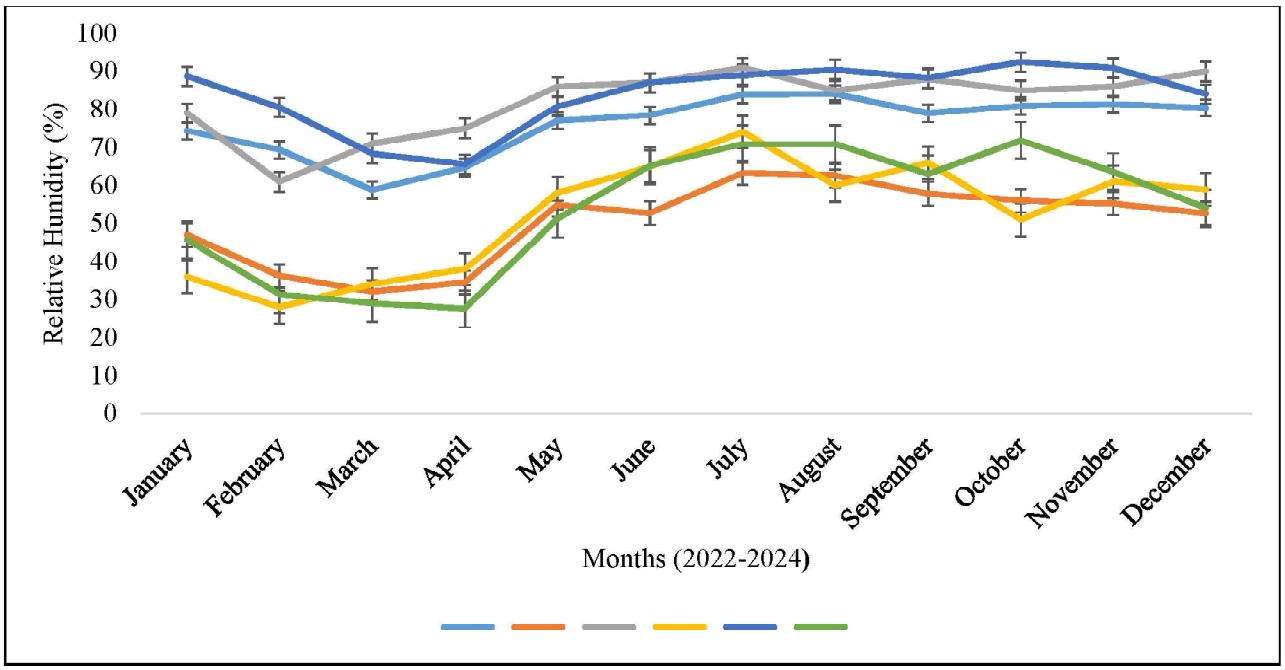

Fig. 2 : Relative humidity (%) recorded during 2022-2024

Table 1a : Initial weight of pot before filling of potting medium

Pot types	Vertical frames (g)	Horizontal benches (g)
4" pot	50	50
6" pot	75	75
Netted pot	50	45

Table 1b : Final weight of pot after filling of potting medium

Particular	Pot type	Vertical frame (g)	Horizontal bench (g)
Coconut husk	4" pot	125	100
	6" pot	300	200
	Netted pot	175	100
Tile bits	4" pot	450	400
	6" pot	900	960
	Netted pot	900	380
Charcoal	4" pot	250	235
	6" pot	650	550
	Netted pot	500	220
Mixed medium (1:1:1 v/v)	4" pot	450	430
	6" pot	780	680
	Netted pot	800	300

Fig. 3 : Vertical frames (left) and horizontal benches (right) used for cultivation

green coloured conical netted pot were used for planting (Table 1a & b). Vertical frames of height 2.65 m, and 3.5 m in length with one-inch squared wire mesh welded on the frames on the base frame of 1 m width were used to mount the pots and horizontal benches of 3.5 m length, 0.9 m width and 0.8 m height were used to place the pots in the polyhouse (Fig. 3). The vertical frames were oriented in N-S direction with 2 layers of shade net on top of frame i.e. 50% and 25%, respectively. Five-tier planting of *Dendrobium* was followed on vertical frame and the plants were spaced at 30 × 30 cm. To meet the nutrient requirement of the plant a biweekly foliar spray of 19:19:19 (N: P_2O_5: K_2O) at 0.2% was applied along with a weekly spray of 0.2% of seaweed extract.

Observations on vegetative growth such as number of pseudo bulbs plant^{-1}, pseudo bulb length (cm), internodal length (cm), number of leaves plant^{-1}, leaf length (cm), leaf width (cm) and leaf area (cm^2), flowering parameters such as days taken for spike initiation, spikes plant^{-1}, florets spike^{-1}, spike length (cm), floret diameter (cm) and longevity of spike on the plant (days), vase life were recorded at monthly intervals and physiological parameters i.e. relative water content (%), specific leaf area (cm^2), photosynthetic rate (µmol m^{-2}s^{-1}), stomatal conductance (m mol m^{-2}s^{-1}), transpiration rate (m mol m^{-2}s^{-1}), total CHO content (mg g^{-1}) and total chlorophyll content (mg g^{-1}) were recorded at the end of the experiment. Data of two years were pooled and analyzed to assess the influence of the three factors and their interaction on plant growth and flowering performance. The cost benefit ratio was also analyzed to arrive at the economic feasibility.

The statistical analysis was done using SPSS 9.4 package. Comparison of the treatments means was done using critical difference at 1% level (IBM Corp., 2020).

RESULTS AND DISCUSSION

Vegetative parameters

Orchids grown in M_4 (mixed medium) demonstrated maximum number of pseudo bulbs (3.73), pseudo bulb length (20.04 cm) and internodal length (4.80 cm) (Table 2). The results are in accordance with findings of Lakshanthi & Seran (2019) and Indumathi et al. (2003). M_2 (charcoal medium) resulted in the highest number of leaves (4.64), leaf length (11.56 cm), leaf width (4.18 cm) and leaf area of 40.47 cm^2. Similar results were recorded by Bhumika et al. (2022) and Wirawati & Priyanto (2022). Conversely, M_3 (tile bits medium) recorded lowest vegetative growth. Plants in P_3 (netted pots) demonstrated the highest vegetative growth with 3.67 number of pseudo bulbs, pseudo bulb length (19.91cm), internodal length (4.76), leaf number (4.53), leaf length (11.46 cm), leaf width (4.11 cm) and leaf area (40.08 cm^2). Conversely, P_2 (6-inch plastic pots) recorded the minimum growth parameters. The growing structure had a substantial impact, with B_2 (vertical frames) achieving the highest number of pseudo bulbs (3.76), pseudo bulb length 20.28 cm, internodal length (4.84), leaf number (4.64),

Table 2 : Influence of potting medium, pot type and growing structure on vegetative parameters of *Dendrobium* cv. Emma White

Treatment	No. of pseudo bulbs	Pseudo bulb length (cm)	Internodal length (cm)	No. of leaves plant^{-1}	Leaf length (cm)	Leaf width (cm)	Leaf area (cm^2)
Factor A: Media (M)							
M_1 : Coconut husk	3.49	19.20	4.66	4.46	10.96	3.96	36.54
M_2 : Charcoal	3.67	19.99	4.78	4.64	11.56	4.18	40.47
M_3 : Tile bits	2.99	16.66	4.28	3.84	9.40	3.36	26.79
M_4 : Mixed medium (1:1:1 v/v)	3.73	20.04	4.80	4.56	11.48	4.12	40.07
S.Em±	0.011	0.100	0.016	0.018	0.048	0.022	0.269
CD (P = 0.01)	0.04	0.38	0.06	0.07	0.18	0.08	1.02
Factor B: Pot size (P)							
P_1 : 4"	3.43	18.78	4.61	4.38	10.70	3.89	35.15
P_2 : 6"	3.31	18.24	4.52	4.22	10.39	3.71	32.67
P_3 : Netted	3.67	19.91	4.76	4.53	11.46	4.11	40.08
S.Em±	0.009	0.086	0.014	0.016	0.041	0.019	0.233
CD (P = 0.01)	0.03	0.33	0.05	0.06	0.16	0.07	0.88
Factor C: Benches/Frames (B)							
B_1 : Horizontal bench	3.18	17.67	4.42	4.12	9.99	3.61	30.47
B_2 : Vertical frames	3.76	20.28	4.84	4.64	11.71	4.20	41.46
S.Em±	0.007	0.070	0.012	0.013	0.034	0.016	0.190
CD (P = 0.01)	0.03	0.27	0.04	0.05	0.13	0.06	0.72
C.V. (%)	1.288	2.229	1.492	1.774	1.868	2.404	3.171

leaf length (11.71 cm), leaf width (4.20 cm) and leaf area (41.46 cm^2) in comparison to B_1 (horizontal benches).

Plants grown on mixed medium in netted pots on vertical frames ($M_4P_3B_2$) resulted in the highest pseudo bulb parameter (Table 3) with 4.40 pseudo bulbs $plant^{-1}$, pseudo bulb length (23.35 cm) and internodal length (5.25 cm). Notably, plants grown on charcoal mediam in netted pots on vertical frames ($M_2P_3B_2$) demonstrated the highest number of leaves $plant^{-1}$ (5.18), leaf length (13.78 cm), leaf width (4.94 cm) and leaf area (55.99 cm^2). This might be because of fact that charcoal allows excellent water drainage and retains optimum amount of moisture, provides good supply of oxygen to roots and acts as a buffer by maintaining neutral pH, preventing drastic fluctuations that could stress plants which is necessary for orchid cultivation. Results are in accordance with Gupta & Saravanan (2017) and Bhumika et al. (2022) in orchids. The netted pots also allow better aeration enhanced plant growth and development. In contrast, the least favorable results were registered in plants grown on horizontal benches with tile bits in 6-inch plastic pots ($M_3P_2B_1$). This might be due to the fact that terracotta tile bits are compact in nature reducing air circulation does not retain adequate moisture along

Table 3 : Interaction effect of potting medium, pot type and growing structure on vegetative parameters of *Dendrobium* cv. Emma White

Treatment		No. of pseudo bulbs	Pseudo bulb length (cm)	Internodal length (cm)	No. of leaves $plant^{-1}$	Leaf length (cm)	Leaf width (cm)	Leaf area (cm^2)
$M_1P_1B_1$		3.25	18.18	4.48	4.35	10.30	3.77	32.50
$M^1P^1B^1$		3.69	20.02	4.81	4.64	11.54	4.14	39.72
$M^1P^1B^2$		3.19	18.03	4.46	4.27	10.15	3.71	31.60
$M^1P^2B^1$		3.56	19.59	4.72	4.58	11.16	4.03	37.36
$M^1P^2B^2$		3.10	17.29	4.35	4.03	9.71	3.55	28.96
$M^1P^3B^1$		4.15	22.10	5.13	4.92	12.90	4.56	49.08
$M^1P^3B^2$		3.33	18.59	4.57	4.39	10.46	3.81	33.42
$M^2P^1B^1$		3.91	20.50	4.92	4.71	12.01	4.33	43.31
$M^2P^1B^2$		3.47	19.28	4.67	4.53	10.99	3.98	36.39
$M^2P^2B^1$		3.67	19.83	4.78	4.61	11.42	4.11	39.07
$M^2P^2B^2$		3.29	18.47	4.54	4.42	10.72	3.88	34.66
$M^2P^3B^1$		4.36	23.29	5.22	5.18	13.78	4.94	55.99
$M^2P^3B^2$		2.96	16.40	4.25	3.82	9.24	3.42	26.58
$M^3P^1B^1$		3.16	17.70	4.42	4.19	9.89	3.67	30.41
$M^3P^1B^2$		2.69	15.16	4.07	3.39	8.56	2.90	20.75
$M^3P^2B^1$		2.88	16.13	4.21	3.70	9.17	3.18	24.55
$M^3P^2B^2$		2.85	15.85	4.15	3.48	8.75	3.10	23.10
$M^3P^3B^1$		3.38	18.70	4.60	4.48	10.82	3.93	35.32
$M^3P^3B^2$		3.14	17.49	4.37	4.12	9.76	3.58	29.33
$M^4P^1B^1$		4.02	21.34	5.06	4.81	12.41	4.44	45.88
$M^4P^1B^2$		3.06	17.06	4.30	3.94	9.49	3.48	27.67
$M^4P^2B^1$		3.96	20.82	4.96	4.76	12.19	4.34	43.99
$M^4P^2B^2$		3.79	20.20	4.88	4.67	11.73	4.17	40.70
$M_4P_3B_2$		4.40	23.35	5.25	5.08	13.30	4.73	52.83
M × P	S.Em. ±	0.018	0.173	0.028	0.032	0.083	0.038	0.466
	C.D. (1%)	0.07	0.65	0.11	0.12	0.31	0.15	1.77
M × B	S.Em. ±	0.015	0.141	0.023	0.026	0.068	0.031	0.380
	C.D. (1%)	0.06	0.53	0.09	0.10	0.26	0.12	1.44
P × B	S.Em. ±	0.013	0.122	0.020	0.022	0.059	0.027	0.329
	C.D. (1%)	0.05	0.46	0.08	0.09	0.22	0.10	1.25
M × P × B	S.Em. ±	0.026	0.244	0.040	0.045	0.117	0.054	0.658
	C.D. (1%)	0.10	0.93	0.15	0.17	0.44	0.21	2.50
C.V. (%)		1.288	2.229	1.492	1.774	1.868	2.404	3.171

Table 4 : Influence of potting medium, pot type and growing structure on flowering attributes of *Dendrobium* cv. Emma White

Treatment	Days for spike initiation	No. of spikes plant^{-1}	No. of florets spike^{-1}	Spike length (cm)	Floret diameter (cm)	Longevity of spike on plant (days)	Vase life (days)
Factor A: Media (M)							
M_1 : Coconut husk	193.39	6.87	5.53	34.45	5.49	47.33	30.39
M_2 : Charcoal	187.78	7.22	6.00	39.26	5.66	53.06	34.00
M_3 : Tile bits	207.33	6.17	4.49	23.13	4.88	33.89	21.00
M_4 : Mixed medium (1:1:1 v/v)	192.94	7.20	5.80	37.41	5.58	49.33	31.61
S.Em±	0.772	0.051	0.058	0.347	0.033	0.435	0.331
CD (P = 0.01)	2.93	0.19	0.22	1.32	0.13	1.65	1.26
Factor B: Pot size (P)							
P_1 : 4"	195.17	6.75	5.36	33.07	5.41	45.75	29.38
P_2 : 6"	198.79	6.58	5.10	30.73	5.22	42.75	27.13
P_3 : Netted	192.13	7.26	5.91	36.89	5.58	49.21	31.25
S.Em±	0.669	0.044	0.051	0.301	0.029	0.377	0.287
CD (P = 0.01)	2.54	0.17	0.19	1.14	0.11	1.43	1.09
Factor C: Benches/Frames (B)							
B_1 : Horizontal bench	201.97	6.39	4.92	27.79	5.18	38.83	24.39
B_2 : Vertical frames	188.75	7.34	5.99	39.34	5.63	52.97	34.11
S.Em±	0.546	0.036	0.041	0.246	0.023	0.307	0.234
CD (P = 0.01)	2.07	0.14	0.16	0.93	0.09	1.17	0.89
C.V. (%)	1.677	3.164	4.543	4.392	2.595	4.019	4.801

with alkaline pH is not favourable for *Dendrobium* cultivation and combined with plastic pot that does not provide adequate air circulation resulting in limited root expansion and growth.

Flowering, yield and vase life parameters

Orchids in M_2 showed the earliest spike initiation at 187.78 days and resulted in superior flowering attributes with the longest vase life (34 days). The results were in accordance with Bhumika et al. (2022) and Wirawati & Priyanto (2022). In contrast, M_3 resulted in inferior flowering attributes with the shortest vase life (21 days) (Table 4). P_3 recorded superior flowering characteristics, with early spike emergence (192.13 days) and enhanced vase life (31.25 days), while, P_2 recorded inferior flowering parameters and vase life (27.13 days). B_2 provided the best support for flowering, resulting in the earliest spike emergence (188.75 days) and longest vase life (34.11 days). Whereas, B_1 registered inferior flower parameters with shortest vase life of 24.39 days.

The plants grown with charcoal potting medium in netted pots on vertical frames ($M_2P_3B_2$) registered significant interaction effect for flowering performance with spike initiation at 175.33 days, yield (8.88 spikes plant^{-1}), florets spike^{-1} (7.67), spike length (49.38 cm), floret diameter (6.30 cm), spike longevity on plant (62.33 days) and vase life (42 days). This might be attributed to fact that charcoal as a potting medium ensures excellent drainage, optimum moisture retention and aeration fostering healthy roots and efficient nutrient uptake with higher CHO content. Netted pots enhance airflow, promoting root development while vertical frames support epiphytic growth, ensuring optimal light exposure and airflow. This setup boosts photosynthesis, reduces light competition and enhances flowering, yielding more spikes with larger and long-lasting blooms. Results are in accordance with Bhumika et al. (2022) in *Dendrobium*. In contrast, plants grown on horizontal benches in 6-inch pots with tile bits as the potting medium ($M_3P_2B_1$) recorded the lowest flowering metrics (Table 5).

Table 5 : Interaction effect of potting medium, pot type and growing structure on flowering parameters of *Dendobium* cv. Emma White

Treatment		Days for spike initiation	No. of spikes plant^{-1}	No. of florets spike^{-1}	Spike length (cm)	Floret diameter (cm)	Longevity of spike on plant (days)	Vase life (days)
$M_1P_1B_1$		196.67	6.53	5.20	30.22	5.41	41.00	26.33
$M_1P_1B_2$		187.67	7.09	5.80	40.41	5.60	56.00	36.33
$M_1P_2B_1$		198.00	6.48	5.12	29.39	5.37	39.00	26.33
$M_1P_2B_2$		192.00	6.86	5.71	37.95	5.51	51.67	32.33
$M_1P_3B_1$		205.33	6.233	4.64	23.15	5.19	36.00	21.67
$M_1P_3B_2$		182.67	8.02	6.67	45.62	5.88	60.33	39.33
$M_2P_1B_1$		196.00	6.56	5.34	32.33	5.41	44.00	28.00
$M_2P_1B_2$		183.00	7.48	6.05	42.51	5.67	58.67	38.33
$M_2P_2B_1$		192.33	6.75	5.60	37.05	5.50	50.00	30.33
$M_2P_2B_2$		185.33	7.02	5.80	39.84	5.59	57.33	37.33
$M_2P_3B_1$		194.67	6.60	5.52	34.46	5.46	46.00	28.00
$M_2P_3B_2$		175.33	8.88	7.67	49.38	6.30	62.33	42.00
$M_3P_1B_1$		209.33	6.11	4.29	20.68	4.95	32.67	20.00
$M_3P_1B_2$		199.67	6.41	5.02	27.73	5.30	39.00	24.67
$M_3P_2B_1$		216.00	5.82	3.88	16.82	4.17	25.67	16.67
$M_3P_2B_2$		211.00	6.09	4.14	19.51	4.78	30.33	18.67
$M_3P_3B_1$		213.67	5.95	4.09	18.99	4.61	28.33	17.33
$M_3P_3B_2$		194.33	6.63	5.53	35.06	5.49	47.33	28.67
$M_4P_1B_1$		203.67	6.22	4.95	26.61	5.26	37.00	23.67
$M_4P_1B_2$		185.33	7.60	6.19	44.07	5.70	57.67	37.67
$M_4P_2B_1$		207.67	6.15	4.44	22.24	5.12	33.33	21.00
$M_4P_2B_2$		188.00	7.49	6.09	43.06	5.69	54.67	34.33
$M_4P_3B_1$		190.33	7.23	5.92	41.54	5.65	53.00	33.33
$M_4P_3B_2$		180.67	8.52	7.22	46.94	6.07	60.33	39.67
M × P	S.Em±	1.338	0.089	0.101	0.602	0.057	0.753	0.573
	C.D. (1%)	5.07	0.34	0.38	2.28	0.22	2.86	2.17
M × B	S.Em±	1.092	0.072	0.083	0.491	0.047	0.615	0.468
	C.D. (1%)	NS	0.27	0.31	1.86	0.18	2.33	1.78
P × B	S.Em±	0.946	0.063	0.072	0.426	0.040	0.533	0.405
	C.D. (1%)	3.59	0.24	0.27	1.61	0.15	2.02	1.54
M × P × B	S.Em±	1.892	0.125	0.143	0.851	0.081	1.065	0.811
	C.D. (1%)	7.18	0.48	0.54	3.23	0.31	4.04	3.08
C.V.%		1.677	3.164	4.543	4.392	2.595	4.019	4.801

Correlation of photosythetically active radiation with vegetative parameters and yield

Pearson correlation revealed the positive correlation of PAR with vegetative parameters (Fig. 4) and yield (Table 6) of *Dendrobium*. Further, the yield of *Dendrobium* was subjected to regression analysis (Fig. 5) and results indicated that PAR significantly influenced number of spikes plant^{-1} by 79.30%. This might be due to optimum levels of incident solar radiation (Table 7) accompanied by the suitable micro environment (Fig. 1 & 2) which might have led to the accelerated photosynthesis and accumulation of photo-assimilates in the sink tissues, ultimately resulting in better growth and development. Similar results with increase in growth with light interception was reported (Hosseinzadeh et al., 2021; Currey et al., 2019).

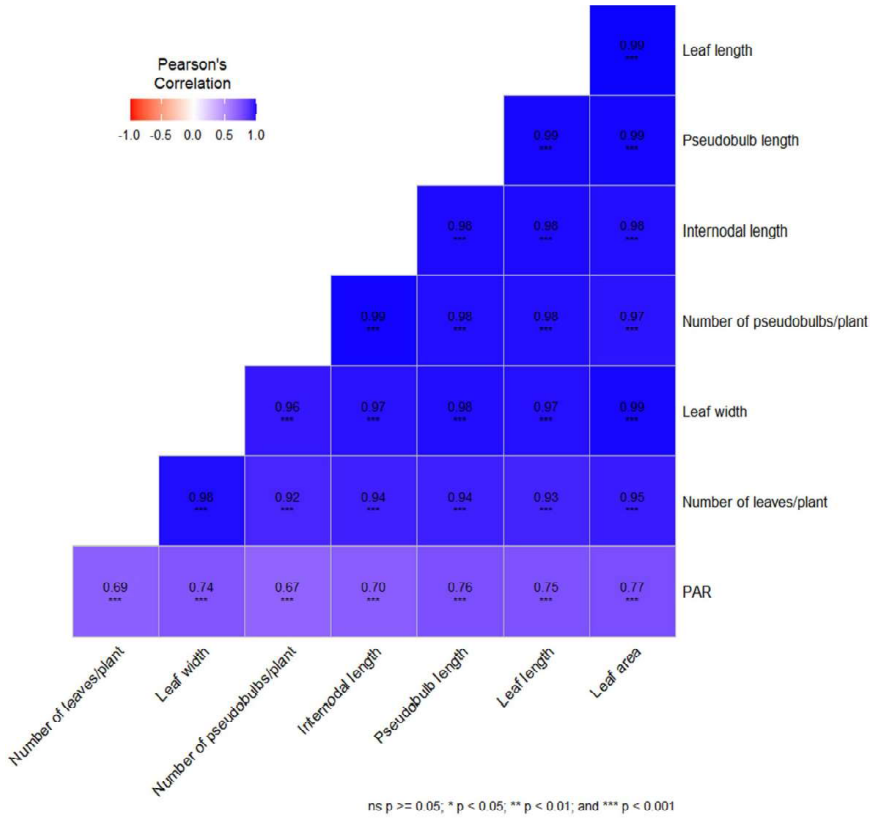

Fig. 4 : Pearson correlation of PAR with vegetative parameters

Table 6 : Pearson correlation between number of spikes plant^{-1} and PAR

Parameters	No. of spikes plant^{-1}	PAR
Number of spikes plant^{-1}	1	0.793***
PAR 0.793***	1	

***Correlation is significant at 0.001 level (two tailed)

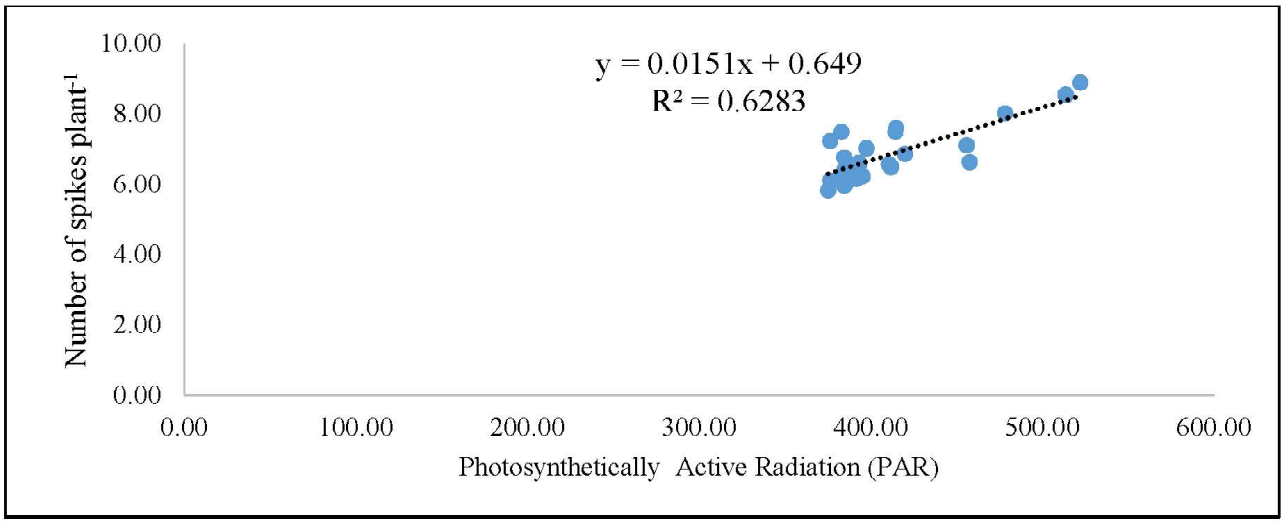

Fig. 5 : Regression model of PAR (µmol m^{-2} s^{-1}) with yield

Table 7 : Data of PAR values recorded on vertical and horizontal growing structures during different seasons from 2022-2024

Growing structure	Tiers	Summer	Winter	Rainy
		(µmol m^{-2} s^{-1})	(µmol m^{-2} s^{-1})	(µmol m^{-2} s^{-1})
Vertical frame	1	171.31	149.46	116.25
	2	119.42	107.3	87.8
	3	94.08	81.46	72.91
	4	92.05	72.08	66.1
	5	72.09	53.37	53.07
Horizontal bench	Places	Summer	Winter	Rainy
		(µmol m^{-2} s^{-1})	(µmol m^{-2} s^{-1})	(µmol m^{-2} s^{-1})
	1	103.02	78.79	70.22
	2	82.92	78.2	65.92
	3	96.39	66.39	60.99

Table 8 : Cost economics of vertical and horizontal growing structure

Treatment	Annual amortized cost of cultivation (Rs.)	No. of plants 200 m^{-2}	No. of flowers $year^{-1}$	Gross returns (Rs.)	Anual net returns (Rs.)	BCR
Vertical frames	365968.6	4600	46000	1380000	1014031	3.77
Horizontal benches	226758.8	1400	9800	294000	67241.17	1.29

Economics

Analysis of the cost benefit ratio (Table 8) revealed that *Dendrobium* grown on vertical frames resulted in a B:C of 3.77, while, those grown on horizontal benches recorded B:C of 1.29, respectively. This is because more number of plants m^{-2} (2.28%) can be accommodated on vertical frames which in turn leads to increased yield per unit area. These findings are in line with Sangeetha (2023) and Melgarejo et al. (2008).

CONCLUSION

Dendrobium orchids grown on the verti-grow system with charcoal as the potting medium in netted pots demonstrated outstanding performance in both vegetative growth and flowering traits. Durability of charcoal will also reduce the re-potting intervals making it an excellent potting medium for *Dendrobium*. The benefit cost ratio (3.77) was higher in vertical farming system. This innovative approach emerges as a promising recommendation for sustainable and profitable orchid cultivation.

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