International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(10): 126-130
www.biochemjournal.com
Received: 22-08-2024
Accepted: 26-09-2024

Painam Lasya Priya
P.G. Scholar, Department of Floriculture and Landscaping, Dr. Y. S. R Horticultural University, College of Horticulture, Anantharajupeta, Annamayya, Andhra Pradesh, India

R Nagaraju
Principal Scientist and Head, Department of Horticulture, Citrus Research Station, Tirupati, Dr. Y. S. R Horticultural University, Andhra Pradesh, India

M Raja Naik
Professor, Department of Floriculture and Landscaping, Dr. Y. S. R Horticultural University, College of Horticulture, Anantharajupeta, Annamayya, Andhra Pradesh, India

M Kavitha
Senior Scientist, Department of Plant Pathology, Citrus Research Station, Tirupati, Dr. Y.S.R Horticultural University, Andhra Pradesh, India

Corresponding Author:
Painam Lasya Priya
P.G. Scholar, Department of Floriculture and Landscaping, Dr. Y. S. R Horticultural University, College of Horticulture, Anantharajupeta, Annamayya, Andhra Pradesh, India

Impact of growing media on growth of Mexican carpet grass in commercial trays for terrace gardening

Painam Lasya Priya, R Nagaraju, M Raja Naik and M Kavitha

DOI: https://doi.org/10.33545/26174693.2024.v8.i10b.2467

Abstract
Lawn, a fundamental feature in garden landscapes, enhances the aesthetic appeal of both large and small spaces, providing a green backdrop for trees, shrubs, and vibrant flower beds. In addition to recreational use, lawns contribute to erosion control, biodiversity, and offer numerous environmental benefits. Recently, lawns have also been established in terrace gardens, where traditional soil, though common, poses challenges such as heavy weight, weed growth, pest infestations, and disease occurrences. Soil less media, on the other hand, offer advantages like being lightweight, easy to handle, pest-free, and disease-resistant. These attributes make soilless media especially suitable for terrace gardening, as they reduce roof loads and maintain a clean, weed-free environment while being cost-effective. This study was conducted to evaluate the growth of Mexican carpet grass in soilless media for terrace gardening applications. Five soilless media *i.e.*, cocopeat, wood ash, vermiculite, rice hulls, and sand were used individually and in equal combinations, with 17 treatments and 4 replications using soil as the control. Growth, physiological, and biochemical parameters were observed at 30-day intervals from 30 to 120 days after planting (DAP). The results indicated that T_1 (Cocopeat) proved as the best performer, followed by T_3 (Vermiculite) and T_7 (Cocopeat + Vermiculite). Conversely, T_4 (Rice hulls) exhibited the poorest growth and establishment among all treatments.

Keywords: Lawn, garden landscapes, aesthetic appeal, erosion control, biodiversity

Introduction
A lawn is a green space covered with grass, serving both aesthetic and recreational purposes, and is often considered the heart of a garden (Desh Raj, 2008) [2]. Lawns occupy a large proportion of urban green spaces globally (Stewart *et al*., 2009) [11]. Grasses, belonging to the Poaceae family, include around 9,000 species, with 20-25 used for turf production. Turf grasses beautify home lawns, provide safe playing surfaces for athletes, and support recreational activities like golf, while offering economic opportunities for seed and sod producers. Turf grass is part of the "Hidden Agricultural Industry" as it's not commonly surveyed like other crops (Janakiram *et al*., 2015) [4]. Proper maintenance boosts property values by 15-20% and contributes significantly to the million-dollar "Green Industry" (Randhawa and Mukhopadhyay, 1986; Roshini *et al*., 2017) [8, 9].

Lawn provide functional, aesthetic, and recreational benefits, offering comfort and pride to owners. Lawns promote cardiovascular health by improving circulation and reducing the risk of heart attacks (Janakiram *et al*., 2015) [4]. Additionally, one square meter of uncut grass can supply enough oxygen for one person for a year (Minke and Witter, 1982) [7].

Rapid urban expansion has significantly reduced green spaces (Alireza and Mohammad, 2019) [10]. Terrace gardening offers city dwellers a solution by allowing plant cultivation on rooftops and balconies. Green roofs help cool buildings in summer and retain heat in winter (Chidambaram *et al*., 2022) [1]. Additionally, green roofs and walls can improve air quality and enhance the well-being of urban residents.

Incorporating a lawn into terrace gardening enhances beauty, reduces heat, and creates a serene space. However, using traditional soil presents challenges like excessive weight, poor drainage, and the risk of waterlogging and root rot. Transporting heavy soil can also be costly and labor-intensive, while it may introduce weeds. To address these issues, soilless media like coco peat and vermiculite offer practical, lightweight alternatives with better drainage, making them ideal for terrace gardens.

Cocopeat, also known as coir pith is a natural fiber from coconut husks, valued for its aeration, moisture retention, and resistance to bacteria and fungi. It holds 8-9 times its weight in water and can be reused for up to 4 years. Wood ash, rich in potassium, calcium, and trace elements, is an alkaline soil amendment that neutralizes acidity and improves nutrient content. Vermiculite, a heat-expanded mineral, has high water retention and is ideal for hydroponics and propagation. Rice hulls, a by-product of rice milling, improve drainage, while sand, made of fine rock particles, is used in potting and propagation media.

Materials and Methods

The experiment was carried out at Citrus Research Station, Dr. Y.S.R. Horticultural University, Tirupati during 2023-24. Mexican carpet grass (*Axonopus* sps) used for the present study. Dibblings were used for planting. The experiment was carried out by Completely Randomized Design (CRD) having seventeen treatments with four replications. The experiment was consisted with 16 different soilless media combinations viz., T_1 – Cocopeat, T_2 – Wood ash, T_3 – Vermiculite, T_4 – Rice hulls, T_5 – Sand, T_6 – Cocopeat + Vermiculite, T_7 – Cocopeat + Vermiculite, T_8 – Cocopeat + Rice hulls, T_9 – Cocopeat + Sand, T_{10} – Wood ash + Vermiculite, T_{11} – Wood ash + Rice hulls, T_{12} – Wood ash + Sand, T_{13} – Vermiculite + Rice hulls, T_{14} – Vermiculite + Sand, T_{15} – Rice hulls + Sand, T_{16} – Cocopeat + Wood ash + Vermiculite + Rice hulls + Sand and T_{17} – Soil as control. Lawn grass was fed with cow dung slurry and 19:19:19 (@ 1.5 gm/lit) and applied at 15 days interval and necessary care was taken to feed with same quantity nutrient solution. All the media and media combinations were mixed in equal proportions and filled in plastic trays which were obtained from local source at Tirupati and had dimensions of 30 x 24 x 4 cm with care was taken for proper drainage. Carpet grass was planted in the trays at 10x10 cm spacing following dibbling method of planting. All the trays were kept under screen house for one week and then shifted to main field. Irrigation was given daily with rose can throughout the experiment. Observations were taken from three plants per treatment and the data collected was statistically analyzed. Growth parameters and biochemical parameters such as leaf length (cm), leaf width (cm), stem thickness (mm), internodal length (cm), root length (cm), chlorophyll content (mg m^{-2}), no. of days for tiller formation, no. of days for spreading were recorded at 30, 60, 90 and 120 DAP.

Results and discussion

Leaf length (cm)

Highest leaf length was observed in T_1 (Cocopeat) at 30 DAP (4.81), 60 DAP (5.59), 90 DAP (6.09) and 120 DAP (7.18) which is on par with T_3 (Vermiculite) 30 DAP (4.68), 60 DAP (5.33), 90 DAP (6.06) and 120 DAP (6.84) followed by T_7 (Cocopeat + vermiculite) 30 DAP (4.58), 60 DAP (5.14), 90 DAP (5.75) and 120 DAP (7.17). Poor performance was given by T_4 (Rice hulls) 30 DAP (3.48), 60 DAP (4.22), 90 DAP (4.73) and 120 DAP (6.11). The results of present study is in conformity with the findings of Gurusarithan *et al*., (2023) [3] who reported maximum leaf length in Perennial Rye grass when grown in Coir pith + Vermicompost + Paddy husk

Table 1: Leaf length (cm) of Mexican carpet grass as influenced by different media

Treatment	30 DAP	60DAP	90 DAP	120 DAP
T_1	4.81	5.59	6.09	7.18
T_2	4.12	5.12	5.73	6.82
T_3	4.68	5.33	6.06	6.84
T_4	3.48	4.22	4.73	6.11
T_5	4.31	4.80	5.38	6.43
T_6	4.04	4.50	5.67	6.71
T_7	4.58	5.14	5.75	7.17
T_8	4.12	4.58	5.35	6.81
T_9	4.14	4.55	5.35	6.53
T_{10}	4.13	4.56	5.43	6.57
T_{11}	4.02	4.53	5.18	6.24
T_{12}	3.88	4.39	5.21	6.22
T_{13}	4.30	4.80	5.54	6.59
T_{14}	4.12	4.59	5.64	6.40
T_{15}	4.11	4.64	5.21	6.34
T_{16}	4.07	4.68	5.67	6.13
T_{17}	4.05	4.54	5.52	6.73
SEm(±)	0.12	0.10	0.14	0.11
CD @ 5%	0.34	0.27	0.41	0.33

Leaf width (mm)

Highest leaf width was observed in T_1 (Cocopeat) at 30 DAP (1.53), 60 DAP (1.58), 90 DAP (1.64) and 120 DAP (1.66) which is on par with T_3 (Vermiculite) 30 DAP (1.51), 60 DAP (1.55), 90 DAP (1.62) and 120 DAP (1.64) and T_7 (Cocopeat + vermiculite) 30 DAP (1.50), 60 DAP (1.55), 90 DAP (1.58) and 120 DAP (1.61). Poor performance was given by T_4 (Rice hulls) 30 DAP (1.28), 60 DAP (1.34), 90 DAP (1.40) and 120 DAP (1.42). This may be due to excellent water retention capabilities and steady supply of moisture to the plants by Cocopeat media.

Table 2: Leaf width (mm) of Mexican carpet grass as influenced by different media

Treatment	30 DAP	60DAP	90 DAP	120 DAP
T_1	1.53	1.58	1.64	1.66
T_2	1.30	1.36	1.49	1.54
T_3	1.51	1.55	1.62	1.64
T_4	1.28	1.34	1.40	1.42
T_5	1.33	1.40	1.45	1.47
T_6	1.38	1.43	1.58	1.61
T_7	1.50	1.55	1.61	1.64
T_8	1.30	1.35	1.49	1.51
T_9	1.45	1.48	1.51	1.53
T_{10}	1.39	1.42	1.56	1.59
T_{11}	1.40	1.44	1.51	1.54
T_{12}	1.38	1.44	1.54	1.53
T_{13}	1.49	1.54	1.58	1.60
T_{14}	1.30	1.34	1.50	1.53
T_{15}	1.34	1.38	1.47	1.49
T_{16}	1.33	1.37	1.40	1.43
T_{17}	1.38	1.41	1.47	1.50
SEm(±)	0.04	0.03	0.04	0.04
CD @ 5%	0.10	0.10	0.11	0.11

Stem thickness (mm)

Highest stem thickness was recorded in T_3 (Vermiculite) at 30 DAP (0.61), 60 DAP (0.63), 90 DAP (0.67) which is on par with T_1 (Cocopeat) 30 DAP (0.59), 60 DAP (0.62), 90 DAP (0.65) and T_2 (wood ash) 30 DAP (0.58), 60 DAP (0.62), 90 DAP (0.65). There was no significant difference observed during 120 DAP. Lowest stem thickness was recorded in T_4 (Rice hulls) 30 DAP (0.49), 60 DAP (0.52) and 90 DAP (0.57).

Table 3: Stem thickness (mm) of Mexican carpet grass as influenced by different media

Treatment	30 DAP	60DAP	90 DAP	120 DAP
T_1	0.59	0.62	0.65	0.69
T_2	0.58	0.62	0.65	0.69
T_3	0.61	0.63	0.67	0.70
T_4	0.49	0.52	0.57	0.60
T_5	0.50	0.53	0.58	0.61
T_6	0.53	0.53	0.58	0.62
T_7	0.53	0.56	0.61	0.66
T_8	0.58	0.61	0.64	0.63
T_9	0.52	0.55	0.59	0.64
T_{10}	0.54	0.57	0.62	0.66
T_{11}	0.52	0.54	0.58	0.62
T_{12}	0.53	0.55	0.60	0.66
T_{13}	0.50	0.54	0.58	0.63
T_{14}	0.50	0.53	0.57	0.69
T_{15}	0.53	0.57	0.61	0.68
T_{16}	0.55	0.58	0.62	0.63
T_{17}	0.54	0.58	0.61	0.69
SEm(±)	0.02	0.02	0.02	0.02
CD @ 5%	0.05	0.05	0.04	N/A

Internodal length (cm)

Maximum internodal length was observed in T_3 (Vermiculite) at 30 DAP (1.37), 60 DAP (1.68), 90 DAP (2.06) and 120 DAP (2.43) which is on par with T_1 (Cocopeat) 30 DAP (1.34), 60 DAP (1.63), 90 DAP (2.03) and 120 DAP (2.41) and T_7 (Cocopeat + vermiculite) 30 DAP (1.31), 60 DAP (1.62), 90 DAP (2.06) and 120 DAP (2.36). Least performance was given by T_4 (Rice hulls) 30 DAP (1.07), 60 DAP (1.34), 90 DAP (1.70) and 120 DAP (2.05). This may be due to mineral availability from Vermiculite media and good nutrient supply to plants.

Table 4: Internodal length (cm) of Mexican carpet grass as influenced by different media

Treatment	30 DAP	60DAP	90 DAP	120 DAP
T_1	1.34	1.63	2.03	2.41
T_2	1.09	1.65	2.03	2.24
T_3	1.37	1.68	2.06	2.43
T_4	1.07	1.34	1.70	2.05
T_5	1.08	1.36	1.73	2.08
T_6	1.14	1.44	1.79	2.25
T_7	1.31	1.62	2.06	2.36
T_8	1.21	1.42	1.68	2.13
T_9	1.13	1.39	1.71	2.09
T_{10}	1.15	1.41	1.74	2.18
T_{11}	1.09	1.45	1.84	2.08
T_{12}	1.14	1.43	1.79	2.20
T_{13}	1.14	1.38	1.72	2.18
T_{14}	1.15	1.45	1.83	2.30
T_{15}	1.09	1.39	1.71	2.16
T_{16}	1.08	1.22	1.74	2.12
T_{17}	1.17	1.48	1.90	2.33
SEm(±)	0.06	0.06	0.08	0.07
CD @ 5%	0.18	0.18	0.21	0.20

Root length (cm)

Maximum root length was observed in T_1 (Cocopeat) at 30 DAP (16.80), 60 DAP (18.10), 90 DAP (18.63) and 120 DAP (21.11) which is on par with T_3 (Vermiculite) 30 DAP (16.34), 60 DAP (17.48), 90 DAP (18.55) and 120 DAP (20.86) and T_{13} (vermiculite + Sand) 30 DAP (15.44), 60 DAP (16.94), 90 DAP (17.94) and 120 DAP (20.56). Least performance was given by T_4 (Rice hulls) 30 DAP (9.42), 60 DAP (11.38), 90 DAP (11.92) and 120 DAP (12.93). Similar results were reported by Gurusarithan *et al.* (2023) [3] when coir pith + vermicompost + paddy husk (1:1:1) were used in Perennial Rye grass. Cocopeat's high water-holding capacity and porous structure provide consistent moisture and oxygen to the roots, while its good drainage prevents waterlogging and root rot, creating an ideal environment for root development.

Table 5: Root length (cm) of Mexican carpet grass as influenced by different media

Treatment	30 DAP	60DAP	90 DAP	120 DAP
T_1	16.80	18.10	18.63	21.11
T_2	10.94	11.56	16.36	16.88
T_3	16.34	17.48	18.55	20.86
T_4	9.42	11.38	11.92	12.93
T_5	12.58	13.71	15.63	19.55
T_6	13.67	14.33	15.25	18.00
T_7	13.77	15.21	16.66	20.54
T_8	13.86	14.95	15.57	20.02
T_9	13.22	15.16	16.50	19.28
T_{10}	11.78	13.23	14.27	15.82
T_{11}	9.58	12.17	13.25	15.92
T_{12}	9.98	11.60	15.23	17.88
T_{13}	15.44	16.94	17.54	20.56
T_{14}	14.61	16.29	16.89	19.24
T_{15}	10.06	11.37	12.21	12.94
T_{16}	11.31	11.57	13.59	16.01
T_{17}	11.16	12.53	15.08	19.48
SEm(±)	0.41	0.32	0.25	0.36
CD @ 5%	1.17	0.91	0.70	1.02

Total chlorophyll content (mg g^{-1})

Total chlorophyll content was maximum in T_1 (Cocopeat) at 30 DAP (2.94), 60 DAP (2.79), 90 DAP (2.44) and 120 DAP (2.45) which is on par with T_7 (Cocopeat + Vermiculite) 30 DAP (2.89), 60 DAP (2.72), 90 DAP (12.38) and 120 DAP (2.40) and T_3 (vermiculite) 30 DAP (2.88), 60 DAP (2.65), 90 DAP (2.39) and 120 DAP (2.39). Poor performance was given by T_4 (Rice hulls) 30 DAP (1.75), 60 DAP (1.53), 90 DAP (1.23) and 120 DAP (1.24). The results of present study is in conformity with the findings of Taghizadeh *et al.* (2014) [12] where maximum chlorophyll content was recoded in Coco peat + vermicompost treatments. Cocopeat's moisture retention, nutrient availability, and good aeration promote efficient nutrient uptake and photosynthesis, leading to higher chlorophyll content. Its neutral pH also supports optimal nutrient absorption.

Table 6: Total chlorophyll content (mg g^{-1}) of Mexican carpet grass as influenced by different media

Treatment	30 DAP	60 DAP	90 DAP	120 DAP
T_1	2.94	2.79	2.44	2.45
T_2	2.48	2.39	2.32	2.34
T_3	2.88	2.65	2.39	2.39
T_4	1.75	1.53	1.23	1.24
T_5	2.11	2.08	1.89	1.85
T_6	2.13	2.11	1.93	1.91
T_7	2.89	2.72	2.38	2.40
T_8	2.22	2.17	1.93	1.93
T_9	2.18	2.19	1.71	1.38
T_{10}	2.22	2.12	1.85	1.84
T_{11}	2.32	2.20	1.72	1.73
T_{12}	2.31	2.27	1.99	2.01
T_{13}	2.62	2.48	2.26	2.29
T_{14}	2.69	2.46	2.15	2.14
T_{15}	2.49	2.41	1.63	1.40
T_{16}	2.40	2.26	2.06	2.04
T_{17}	2.57	2.47	2.11	2.04
SEm(±)	0.01	0.01	0.04	0.06
CD @ 5%	0.04	0.04	0.11	0.16

No. of days for tiller formation (DAP)
Minimum days for tiller formation was observed in T_3 (Vermiculite) (16.50 DAP) which is on par with T_1 (Cocopeat) (16.75 DAP) followed by T_7 (Cocopeat + Vermiculite) (18.75 DAP). Maximum days for tiller formation was observed in T_{15} (Rice hulls + Sand) (24.75 DAP).

Table 7: No. of days for tiller formation, No. of days taken for spreading per sq. mt and weight of 1 sq. ft area (@ 120 DAP) of Mexican carpet grass as influenced by different media.

Treatment	No. of days taken for tiller formation	No. of days taken for spreading per sq. mt	Weight of 1 sq. ft area in kg (@120 DAP)
T_1	16.75	62.50	4.93
T_2	21.00	80.00	9.85
T_3	16.50	63.00	4.95
T_4	23.50	111.25	1.68
T_5	21.50	86.25	11.25
T_6	21.00	83.00	5.18
T_7	18.75	62.50	5.00
T_8	20.50	71.25	4.13
T_9	21.25	71.25	9.78
T_{10}	20.75	77.25	5.35
T_{11}	22.75	76.25	5.10
T_{12}	21.75	88.75	9.70
T_{13}	20.50	76.00	5.00
T_{14}	23.50	78.75	6.78
T_{15}	24.75	92.50	8.90
T_{16}	23.50	106.25	5.25
T_{17}	20.50	71.25	10.18
SEm(±)	0.74	2.11	0.09
CD @ 5%	2.10	5.99	0.26

No. of days taken for spreading per sq. mt (DAP)
Minimum days were taken in T_1 (Cocopeat) and T_7 (Cocopeat + Vermiculite) (62.50 DAP) followed by T_3 (Vermiculite) (63 DAP) for spreading per sq. mt of Mexican carpet grass. Maximum days for spreading were taken in T_4 (Rice hulls) (111.25 DAP).

Weight of 1 sq. ft area (Kg)
Weight of 1 sq. ft area along with media was recorded and minimum weight was recorded in T_4 (Rice hulls) (1.68 kg) followed by T_1 (Cocopeat) (4.93 kg) and T_3 (Vermiculite) (4.95 kg). Highest weight was recorded in T_5 (Sand) (11.25 kg) followed by T_{17} (Soil) (10.18 kg) and T_2 (Wood ash) (9.85 kg).

Conclusion
Among all treatments, T_1 (Cocopeat) demonstrated the best performance, followed by T_3 (Vermiculite) and T_7 (Cocopeat + Vermiculite) and are on par with each other. In contrast, T_4 (Rice hulls) and T_{15} (Wood ash + Rice hulls) exhibited suboptimal results, primarily due to their poor water retention and quick-drying nature, which hindered plant growth. Based on the morphological and biochemical observations either Cocopeat or combination of Cocopeat with Vermiculite (50:50 ratio) can be recommended as the ideal medium for the commercial growth and transport of Mexican carpet grass. Its lightweight properties facilitate ease of handling and application, while its excellent moisture retention, nutrient availability, and aeration promote robust root development and early tiller formation. In conclusion, cocopeat not only proves to be economically feasible and suitable for ready-to-use trays in terrace gardening but also creates optimal conditions for successful plant growth. Vermiculite complements these benefits, making both media excellent choices for sustainable urban gardening practices. Together, they offer a highly effective solution for both commercial and home gardeners.

Future line of work
To investigate the suitability of organic (decomposable) trays for growing Mexican carpet grass. To explore the effectiveness of soil less media in vertical gardening for growing Mexican carpet grass. To explore the potential of incorporating organic additives into soil less media for cultivating carpet grass. To examine the long-term durability of Mexican carpet grass grown in soil less media.

Acknowledgement
I would like to express my sincere gratitude to the advisory committee for their invaluable guidance and ongoing support throughout my research. I am also appreciative of Citrus Research Station, Tirupati, Dr. YSRHU and Department of Floriculture and Landscaping at the College of Horticulture, Anantharajupeta-Dr. YSRHU for providing the essential resources and facilities needed to complete this project. Additionally, I extend special thanks to my family and friends for their unwavering encouragement during this project.

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