Effect of Growing Media on Vegetative Growth Parameters of Broccoli (*Brassica oleracea* L. var. *italica*) under Soilless Cultivation"

ABSTRACT

An experiment was conducted at School of Agricultural Sciences, Malla Reddy University, Hyderabad during the year 2024-25 for knowing the potentiality of different growing media with different ratio *viz.,.*Vermicompost (100%), Cocopeat (100%), Perlite (100%), Vermicompost + Cocopeat (70%+30%), Vermicompost + Perlite (70%+30%), Cocopeat + Vermicompost (70%+30%), Cocopeat + Perlite (70%+30%), Perlite + Vermicompost (70%+30%), Perlite + Cocopeat (70%+30%), Vermicompost + Cocopeat + Perlite (40%+40%+20%) .These ten treatments were analyzed in RBD with 3 replications. The higher observed in T_{10} (Vermicompost + Cocopeat + Perlite (40%+40%+20%) *i.e.,* plant height (64.00 cm), leaf length (38.54 cm), leaf width (21.33 cm), number of leaves (15.47), plantspread diameter (77.23 cm) and the lowest plant height (54.87cm) leaf length (31.94 cm), leaf width (17.23cm), number of leaves (11.83), plant spread diameter (67.30 cm) was recorded in the treatment T3 [(Perlite (100%)].

Key words: Broccoli, Growing media, Soilless cultivation, Vermicompost, Cocopeat, Perlite

Introduction

Broccoli (*Brassica oleracea* L. *var. italica*), belonging to the Brassicaceae family, is a cool-season vegetable primarily cultivated for its edible, immature flower heads. The name “broccoli” is derived from the Italian word *broccolo*, meaning "cabbage’s flowering crest." It originates from the Mediterranean region and thrives in temperatures between 20–25°C, with optimal head formation occurring at 15–20°C (Thamburaj and Singh, 2001). There are three major types based on colour: green, purple, and white. Broccoli resembles cauliflower in structure but differs mainly in its inflorescence. Nutritionally, broccoli is considered a "crown

jewel" due to its high levels of vitamins A and C, minerals (iron, calcium), fiber and antioxidants. It also contains essential compounds like ascorbic acid, thiamin, riboflavin, niacin and glucosinolates known for their anticancer properties. The vegetable is mainly consumed fresh in India, while in Europe and the U.S., it is used both fresh and frozen. Steaming and microwaving preserve most of its beneficial compounds, whereas boiling can significantly reduce them. There are two primary broccoli varieties: The heading type, with a central compact head (similar to cauliflower) and sprouting broccoli, which forms multiple smaller heads. Broccoli is a heavy feeder and requires ample nutrients for optimal growth. To overcome issues associated with soil-based cultivation-like pest pressure and nutrient inconsistency-soilless cultivation has gained popularity, especially in protected environments.

Artificial growing media, which exclude natural soil, serve as the foundation in these systems. These media can be organic (e.g., vermicompost, cocopeat, peat, compost) or inorganic (e.g., perlite, vermiculite, rock wool). Each medium provides a stable environment for root anchorage, moisture retention, and nutrient availability. Cocopeat, a by-product of coconut fiber extraction, is chemically stable and retains moisture well. Perlite, a volcanic mineral, enhances aeration and drainage due to its porous nature. Effective media must maintain adequate porosity and particle size to ensure proper air-water balance and facilitate healthy root development (Bilderback *et al*., 2005).

Soilless systems offer several agronomic benefits for broccoli cultivation: precise nutrient and water management, enhanced yield and quality, reduced disease incidence, and efficient water use. Year-round cultivation is possible regardless of soil quality or climate variability. Studies, such as Ghasemi *et al*. (2018), have demonstrated that vermicompost significantly increases broccoli head size and weight, while perlite improves root structure through enhanced aeration, emphasizing the importance of selecting nutrient-rich, balanced media.

Fig 1: Broccoli seedlings in protrays

Material and Methods

The present investigation was conducted in the Experimental Farm, Department of Agriculture, Malla Reddy University, Hyderabad 2024-2025. The methodology followed and the materials used in the present study are detailed below.

List 1-

Treatment detail (Media composition)

Treatment	Components	Ratio
T_1	Vermicompost	(100%)
T_2	Cocopeat	(100%)
T_3	Perlite	(100%)
T_4	Vermicompost + Cocopeat	(70% + 30%)
T_5	Vermicompost + Perlite	(70% + 30%)
T_6	Cocopeat + Vermicompost	(70% + 30%)
T_7	Cocopeat + Perlite	(70% + 30%)
T_8	Perlite + Vermicompost	(70% + 30%)
T_9	Perlite + Cocopeat	(70% + 30%)
T_{10}	Vermicompost + Cocopeat + Perlite	(40% + 40% + 20%)

All the observed data were statistically analysed by the method of analysis of variance The data obtained from different treatments during field experimentation were subjected to the analysis of variance by Randomized Block Design(RBD). The total experimental area was144 m^2. The space between replications was 50 cm and plant to plant 45 cm.

Fig2: Experimental area under fan & pad polyhouse

Result and Discussion

Plant height(cm)

The result reveals that difference were observed among the different growing media in plant height (cm) in broccoli (table 1) during the experiment. the data has collected at different intervals *i.e*, at 30,45, and 60 days after transplanting .The highest plant height was observed in T_{10} (Vermicompost + Cocopeat + Perlite 40% + 40% + 20%) i.e, with (42.06cm,58.50cm and 64.00cm) respectively. However, T_{10} is on par with T_4 (Vermicompost + Cocopeat 70%+30%) with values (41.93cm, 57.26cm, 62.97cm). The lowest plant height was observed in T_3 (Perlite 100%) with (28.03cm 40.14cm and 54.87cm). Vermicompost boosts nutrient availability and microbial activity, enhancing root growth and overall plant height. Combined with cocopeat's moisture retention and perlite's improved drainage, this mix creates ideal conditions for taller broccoli plants. Vermicompost contributed organic matter and beneficial microbes that supported root development and nutrient uptake (Dharnesh, 2019). Cocopeat enhanced moisture retention and root zone aeration, while perlite improved drainage and reduced compaction. This mix ensured optimal nitrogen, phosphorus and potassium availability, essential for vegetative growth and cell expansion (Khan *et al.,* 2019). Thus, the integrated media provided ideal physico-chemical and nutritional conditions for superior plant growth in soilless cultivation systems

Leaf length and Leaf width (cm)

The result showed that the significantly highest leaf length and leaf width among different media with different ratio (table 1) at different intervals at 30,45 and 60 DAT. The highest Leaf length and Leaf width were showed in T_{10} (Vermicompost + Cocopeat + Perlite 40% + 40% + 20%) *i.e,* with (27.19 cm, 38.54 cm and 57.81cm), (17.47cm, 20.94cm and 21.33cm) and it is on par with T_4 (Vermicompost + Cocopeat 70%+30%) *i.e.,* with (25.90cm, 37.96cm and 52.86cm and) and (15.57cm, 20.22cm and 20.50cm) The lowest leaf length and leaf width was observed in T_3 (Perlite 100%) with (17.07cm, 31.94cm and 43.23cm) and (10.42cm, 15.74cm and17.2 cm). The combination of vermicompost, cocopeat and perlite improves nutrient availability, particularly nitrogen and potassium, which are essential for leaf expansion. Enhanced aeration and moisture retention promote efficient physiological processes, supporting greater cell division and elongation in leaves. This results in increased leaf length and width in broccoli plants under optimal soilless conditions.

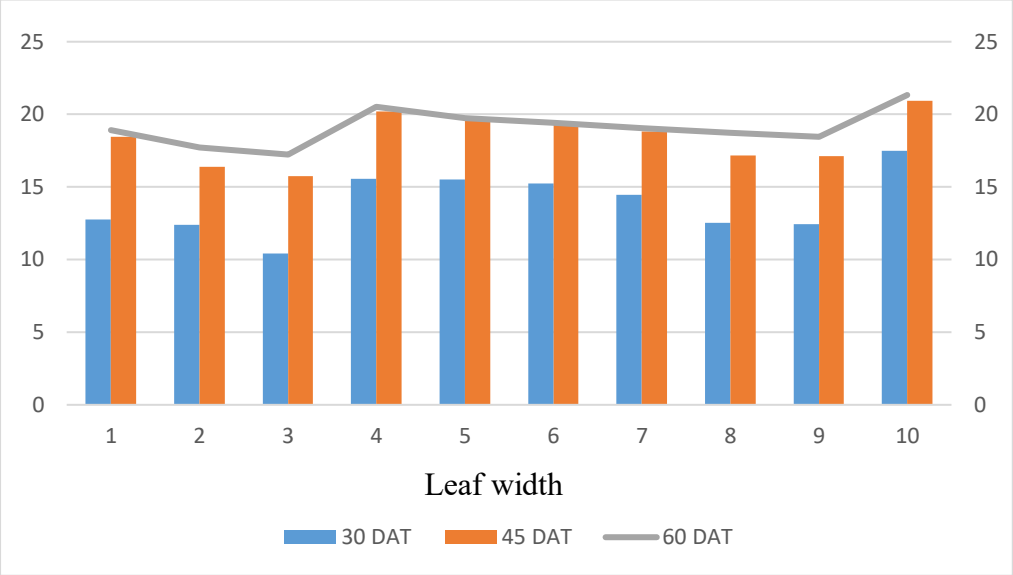
According to Rabbee *et al.* (2020), the rise in leaf number in broccoli is linked to improved nutrient supply from vermicompost, which enhances soil fertility and microbial activity, promoting better nutrient uptake. Organic components like vermicompost, cocopeat, and perlite contribute to increased leaf width by ensuring the availability of key nutrients such as nitrogen, potassium, and calcium. Nitrogen supports vegetative growth, while potassium aids in water regulation and nutrient transport, both essential for leaf development. The presence of N, P, and K enhances cellular activities, leading to increased cell size and number, as also noted by Dharnesh (2019) and Bhat *et al*. (2023).

Fig 3: Measuring brocolli (a) Leaf width(cm) (b) Leaf length(cm)

Table1: Effect of different media on plant height (cm)Leaf length (cm), Leaf width(cm)

Treatments	**Plant height (cm)**			**Leaf length (cm)**			**Leaf width(cm)**		
	30 DAT	**45 DAT**	**60 DAT**	**30 DAT**	**45 DAT**	**60 DAT**	**30 DAT**	**45 DAT**	**60 DAT**
T_1	34.53	50.66	58.50	22.57	34.99	48.65	12.77	18.43	18.93
T_2	28.37	44.46	56.43	18.70	34.29	42.96	12.37	16.40	17.73
T_3	28.03	40.14	54.87	17.07	31.94	43.23	10.42	15.74	17.23
T_4	41.93	57.26	62.97	25.90	37.96	52.86	15.57	20.22	20.50
T_5	41.07	54.49	61.77	25.75	37.61	51.32	15.50	19.58	19.73
T_6	36.13	51.99	59.40	23.63	37.43	50.36	15.25	19.44	19.40
T_7	35.33	51.08	59.07	23.22	35.70	50.06	14.47	18.83	19.07
T_8	32.27	50.48	57.30	22.25	34.73	46.32	12.55	17.17	18.73
T_9	31.04	44.52	57.07	21.15	34.47	44.58	12.43	17.12	18.45
T_{10}	42.06	58.50	64.00	27.19	38.54	57.81	17.47	20.94	21.33

Fig 4: Graphical representation of leaf width (cm) in broccoli under soilless cultivation using different growing media at 30, 45 and 60 DAT.



Number of Leaves/Plant:

Number of leaves / Plant of broccoli was significantly affected by different growing media at different intervals 30,45 and 60 DAT (Table 2). The maximum number of leaves/ plant was absorbed in T_{10} (Vermicompost + Cocopeat + Perlite 40% + 40% + 20%) *i.e,* with (7.30 ,22.47 and 15.47).which was on par with T_4 (6.97, 20.48 and 15.17). While minimum number of leaves /plants was obtained (5.45,12.32 and 11.83). whereas the lowest number of leaves were recorded in T_3 (Perlite 100%) *i.e.,* with (5.45,12.32 and 11.83).

The combination of vermicompost, cocopeat and perlite enhances nutrient availability and root zone aeration, promoting hormonal activity and cell division necessary for leaf initiation. This results in increased leaf production due to improved uptake of nitrogen and other essential nutrients. Vermicompost, as reported by Kumar *et al.* (2023), significantly improves nutrient availability and microbial activity, thereby stimulating robust vegetative growth in crops like broccoli. Its rich nitrogen content promotes chlorophyll formation and cell division, leading to increased leaf formation. Additionally, the improved moisture retention, aeration, and nutrient release from the growing medium enhance root development and photosynthetic efficiency, supporting higher leaf numbers (Chatterjee *et al.,* 2016; Abduli *et al.,* 2013).

Plant Spread Diameter (cm)

The results revealed that Plant spread diameter showed significant difference among the different growing media (table 2) at different intervals 30,45 and 60 DAT. Vermicompost + Cocopeat + Perlite 40% + 40% + 20% (T_{10}) recorded the highest plant spread diameter *i.e* with (44.00cm, 75.64cm and 77.23cm) and it is on par with T_4 (Vermicompost + Cocopeat 70%+30%) *i.e.,* with values (42.02cm, 67.27cm and 72.60cm). Whereas, the lowest plants spread diameter was recorded in T_3 (Perlite 100%) *i.e.,* with (28.90cm. 42.68cm, 67.30cm). Broccoli plant spread was likely improved due to better soil aeration and structure from vermicompost, cocopeat and perlite, which support root expansion and vegetative growth (Arancon *et al.,* 2004). These organic substrates, rich in humic substances, also facilitate gradual nutrient release, enhancing overall plant performance, as similarly reported by Arancon *et al*. (2004). Utilization of organic amendments, notably vermicompost, has been associated with improved soil fertility and heightened microbial activity, which in turn enhances root growth and nutrient uptake in broccoli (Naorem *et al.,* 2023). This improved root system ensures stronger plant anchorage and efficient nutrient transport, contributing to greater plant spread. Enhanced vegetative development leads to a broader canopy, which supports better light capture and photosynthetic efficiency. As a result, overall plant vigour and productivity are elevated. Similar observations were also reported by Dharnesh (2019).

Table 2: Effect of different soilless media on Number of leaves, Plant Spread Diameter(cm)

Treatments	**Number of leaves(cm)**			**Plant Spread diameter(cm)**		
	30 DAT	**45 DAT**	**60 DAT**	**30 DAT**	**45 DAT**	**60 DAT**
T_1	6.17	19.44	12.70	38 .81	54.04	69.77
T_2	5.80	13.92	12.63	31.77	46.59	68.53
T_3	5.45	12.32	11.83	28.90	42.68	67.30
T_4	6.97	20.48	15.17	42.02	67.27	72.60
T_5	6.73	19.94	14.77	42.55	70.57	76.90
T_6	6.63	19.92	14.40	41.75	60.44	72.37
T_7	6.30	19.24	13.10	39.43	55.65	71.80
T_8	6.10	17.17	12.50	38.73	50.28	69.50
T_9	5.97	18.40	12.37	35.93	50.18	69.63
T_{10}	7.30	22.47	15.47	44.00	75.64	77.23

CONCLUSION:

The study revealed that different growing media compositions significantly affected broccoli's morphological traits and yield over a 60day period. Soilless cultivation using various media combinations demonstrated promising results under controlled conditions. Among the treatments, T_{10} (Vermicompost + Cocopeat + Perlite at 40%+40%+20%) showed the highest yield performance, followed closely by T_4 (Vermicompost + Cocopeat at 70%+30%). These combinations enhanced plant growth and yield potential, making them agronomically and economically viable. Therefore, such media blends are recommended for efficient soilless broccoli cultivation in protected environments.

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