



Effect of Potting Media on Seed Germination and Seedling Growth of Jackfruit (*Artocarpus heterophyllus*) under Pryagraj Agro Climatic Condition

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present study aims to investigate the Effect of potting media on seed germination and seedling growth of jackfruit at the Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, during the period 2023-24. The experiment was laid in completely randomized block design with three replications and ten treatment combinations. viz, T0 Control(soil), T1 (Soil + FYM + cocopeat)(3:1:1), T2 (Soil + vermicompost + cocopeat) (2:1:2), T3 (Soil + FYM + cocopeat)(1:1:3), T4 (Soil + FYM + vermicompost) (1:2:1), T5 (Soil +

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vermicompost)(1:1), T6 (Soil + FYM + vermicompost)(1:1:1) T7 (Soil + FYM + vermicompost)(2:2:2), T8 (Soil + FYM)(2:2), T9 (Soil + vermicompost)(2:2). The seeds were kept in moist area so seed do not dry. The seeds were then sown in the pre-filled polybags and various parameters related to Germination Parameters, Growth Parameters, Economics and Survival were evaluated. Present investigation found that treatment T9 (Soil + vermicompost) (2:2). Performed best in term of Germination percentage, Number of leaves, Plant height, Leaf length, Chlorophyll content and stem Diameter. The lowest observation was recorded in T1 (Control)(soil). The highest B:C Ratio (2.23) was found in the same treatment

Keywords: FYM; cocopeat; vermicompost; jackfruit.

1.INTRODUCTION

Germination is a critical stage in the life cycle of plants, marking the transition from seed to seedling and laying the foundation for subsequent growth and development. Jackfruit (*Artocarpus heterophyllus*), a tropical fruit tree native to South and Southeast Asia, is renowned for its large, sweet, and aromatic fruits. Propagation of jackfruit often begins with the germination of its seeds, a process that can be influenced by various factors, including the germination medium used [1,2].

In horticulture, the choice of germination medium plays a pivotal role in providing optimal conditions for seedling emergence and early growth. Different media offer varying levels of moisture retention, aeration, and nutrient availability, thereby influencing the germination success rate and subsequent seedling vigor. Understanding the characteristics of different germination media is essential for growers seeking to propagate jackfruit seedlings efficiently [3,4,5,6].

In this context, this paper explores the diverse range of media commonly utilized for germinating jackfruit seeds. From traditional methods to modern innovations, each medium offers unique advantages and considerations for promoting successful germination and establishing healthy seedlings. By examining the characteristics and outcomes associated with different germination media, growers can make informed decisions to optimize the germination process and enhance the overall success of jackfruit propagation [7].

Healthy soil creates healthy plants that are less vulnerable to pests and disease. Healthy soil sticks together and has a sponge-like structure. It holds moisture and prevents erosion.

Holds necessary nutrients for plant growth, filters rainwater and regulates its discharge. Buffers against pollutants, protecting groundwater quality, Improves moisture retention. Reduces

soil erosion, enhances nutrient absorption and Protects against pathogens and insects.

Using FYM in agriculture offers many benefits to farmers. For example, FYM can create a nutrient-rich environment in the soil, allowing plants to better absorb water and minerals.

Increases soil fertility, a natural source of available nitrogen, FYM adds humus and slow releasing nutrients to the soil, aids water and nutrient retention helps break down heavy soils, adds structure to light and sandy soils, and attracts worms [8].

The major benefits of Vermicompost to plants is Vermicompost nutrients are easily available for the plants to uptake minerals and nutrients. Vermicompost is less cost rather than other fertilizers. It is very easy to produce or prepare Vermicompost. Any farmer can make Vermicompost at their own fields [9].

Promotes Aeration and Reduces Erosion: The earthworms' action in the composting process creates tiny channels in the soil, which improves aeration and reduces soil erosion.

Helps soil retain moisture, can kill some pathogens, boosts the nutrients available to plants, helping seeds to germinate more quickly, grow faster, develop better root systems and produce higher yields, Increases microorganism populations and suppresses pests [10,11,12,13].

1.1 Benefit of Cocopeat

Cocopeat keeps the soil free of weeds. It has a neutral soil pH. Peat is acidic. Cocopeat offers better moisture retention and aeration. It provides good resistance against root diseases.

Increased Water Capacity Cocopeat can increase the water holding capacity of your potting mix, at the same time that it also increases the porosity of your soil.

It requires very less cocopeat and has better nutrient absorption [14,15,16]. Thus this experiment aimed to evaluate best potting media of jackfruit for good seed germination and survival percentage and to estimate the economics of different treatment combination of jack fruit seedling.

2. MATERIALS AND METHODS

The present investigation was carried out in the department of Horticulture, Sam Higginbottom Institute of Agriculture, Technology and Sciences which is located in Prayagraj and it is situated in the south-east part of Uttar Pradesh 2023- 24 India. Prayagraj falls under agroclimate zone IV which is named as "middle Gangetic plains" the site of experiment is located at 25.57° N latitude 81.51° E longitude and 98 meter above the sea level the temperature falls down as low as 4-5°C during winter, the average rainfall in this area is around 798.900 mm annually with maximum concentration during July to September with few showers and drizzles in winter also.

Randomized Block Design was used to set up the experiment, and nine treatments were reproduced three times. The nine treatments consist of T0 Control(soil), T1 (Soil + FYM + cocopeat) (3:1:1), T2 (Soil + vermicompost + cocopeat) (2:1:2), T3 (Soil + FYM + cocopeat) (1:1:3), T4 (Soil + FYM + vermicompost) (1:2:1), T5 (Soil + vermicompost)(1:1), T6 (Soil + FYM + vermicompost) (1:1:1) T7 (Soil + FYM + vermicompost) (2:2:2), T8 (Soil + FYM)(2:2), T9 (Soil + vermicompost) (2:2). Effect of potting media were applied at the time of seed sowing and observations were recorded on Germination percentage, Number of leaves, Plant height, Leaf length, Chlorophyll content and stem Diameter.

2.1 Observations Recorded

The following observations were recorded and average was computed at growing successive stages.

2.1.1 Germination (%)

The germination percentage refers to the proportion of seeds that successfully sprout and begin to grow under specific conditions. It is commonly expressed as a percentage and is calculated by dividing the number of germinated seeds by the total number of seeds tested, then multiplying by 100.

Here's the formula:

$$\text{Germination percentage} = \frac{\text{Number of germinated seeds}}{\text{Total number of seeds}} \times 100$$

2.1.2 Plant height (cm)

A measuring scale was used to measure the height of the plant from ground level to the tip of the seedling at different intervals i.e. 30, 60, 90 Days after germination and 30 days after transplanting.

2.1.3 Numbers of leaves per seedling

Total number of leaves is counted in all treatments each replications at 30, 60, 90 DAS.

2.1.4 Leaf length (cm)

Measuring scale is used for the measurement of leaf length. To measure it the scale was aligned along the midrib of the leaf, starting from the base to the tip, and the measurement was recorded in centimetres (cm) at different intervals i.e. 30, 60, 90.

2.1.5 Stem Girth (cm)

Girth of the stem was measured with the help of digital vernier calliper at 90 Days after germination.

2.1.6 Chlorophyll Content (SPAD Value)

Chlorophyll is the most important pigment for photosynthesis and growth. The determination of chlorophyll content in plant leaves can be used to investigate plant physiological and nutritional status, and consequently has important implications on crop stress. Chlorophyll content was measured after 90 days after germination with the help of SPAD meter.

2.1.7 Cost of Cultivation (Rs.)

The cost of cultivation refers to the total expenses incurred in growing. It encompasses all the costs associated with various inputs and activities involved in the cultivation process.

2.1.8 Gross income (Rs.)

Gross return, also known as gross revenue, refers to the total income generated. Gross

return is calculated by multiplying the quantity of agricultural produce sold by its selling price per unit.

Here's the formula for calculating gross return:

Gross Return = Quantity of Produce Sold x Selling Price per Unit

2.1.9 Net income (Rs.)

Net return refers to the profit remaining after deducting all expenses, including production costs and overhead, from the gross revenue generated.

The formula for calculating net return is:

Net Return=Gross Return – Total Production Costs – Overhead Expenses

2.1.10 B:C ratio

The Benefit-Cost Ratio (B:C ratio) is a financial metric used to assess the profitability or economic viability of an investment or project. B:C ratio is commonly used to evaluate the returns generated.

The B:C ratio is calculated by dividing the total benefits of the investment by the total costs:

$$B: C \text{ Ratio} = \frac{\text{Total Benefits}}{\text{Total Costs}}$$

3. RESULTS AND DISCUSSION

Germination %, Days to required initial germination, and chlorophyll content all showed in the data (Table 1). Result on potting media indicated that T1 (Soil + FYM + Cocopeat) recorded the minimum germination% (38.80%) over all other treatment where as Treatment T9 (Soil + vermicompost) was found to be maximum germination% (88.80%).

Result on potting media indicated that T1 (Soil + FYM + Cocopeat) recorded the minimum number of days required for initial germination (14.12 days) over all other treatment where as Treatment T9 (Soil + vermicompost) was found to be maximum number of days(18.89 days).

Result on potting media indicated that T1 (Soil + Fym + Cocpeat) recorded the minimum number

of chlorophyll content (44%) over all other treatment where as Treatment T9 (Soil + vermicompost) was found to be maximum number chlorophyll content (69%).

Seeds of jackfruit are germinated with vermicompost, FYM, cocopeat they increasing cell wall plasticity and provided better water absorption, metabolic activity increases, respiration ramps up. Oxygen is consumed, and carbon dioxide is released as the embryo converts stored energy into usable forms then emergence of the radicle, which is the embryonic root. It grows downward into the soil, anchoring the emerging plant and absorbing water and nutrients from the soil. After this Cotyledon Expansion takes palce it produces true leaves help in photosynthesis [17]. Root System and Shoot is established. Then maturation takes place with sufficient growth and development, the seedling matures into an adult plant capable of reproduction. environmental factors such as temperature, light, and soil conditions play crucial roles in regulating germination [18].

Leaf length, Stem Diameter all showed in the data (Table 2). Result on potting media indicated that T1 (soil + FYM + cocopeat) recorded the minimum leaf length in seedlings in 30 days (1.3cm), 60 days (4.7cm) and 90 days (10.6cm) respectively. Whereas T₉ (soil + vermicompost) was found to be maximum height of seedlings 30 days (2.1cm), 60 days(7.8cm) and in 90 days (14.1cm) respectively.

Result on potting media indicated that T1 (soil + FYM + cocopeat) recorded the minimum stem diameter in seedlings in 30 days (0.2mm), 60 days (0.2mm) and in 90 days (0.8mm) respectively whereas T₉ (soil + vermicompost) was found to be maximum height of seedlings 30 days (0.7mm), 60 days(0.9mm) and in 90 days (1.7mm) respectively.

Leaf length and stem diameter jackfruit seedlings is increased by vermicompost and cocopeat by adding these nutrients ability is smother by the cocopeat but vermicompost have more nutrient availability. and provided better water absorption, metabolic activity increases and respiration ramps up. pH Regulation Cocopeat tends to have a slightly acidic to neutral pH, which is generally suitable for most plants. Proper pH levels ensure optimal nutrient uptake, which can impact overall plant growth, including leaf and stem development [7].

Table 1. Treatment details

Treatment	Treatment Composition
T ₀	Control
T ₁	Soil + FYM + cocopeat (3:1:1)
T ₂	Soil + vermicompost + cocopeat (2:1:2)
T ₃	Soil + FYM + cocopeat (1:1:3)
T ₄	Soil + FYM + vermicompost (1:2:1)
T ₅	Soil + vermicompost (1:1)
T ₆	Soil + FYM + vermicompost (1:1:1)
T ₇	Soil + FYM + vermicompost (2:2:2)
T ₈	Soil + FYM (2:2)
T ₉	Soil + vermicompost (2:2)

Table 2. Effect of potting media on Germination %, Days to germinate and chlorophyll content of jackfruit

Treatment Notion	Treatment details	Germination %	Days to required initial germination	Chlorophyll content
T ₀	Control	44.57	19.65	55.5
T ₁	Soil + FYM + cocopeat (3:1:1)	38.80	14.12	44.6
T ₂	Soil + vermicompost + cocopeat (2:1:2)	72.20	19.58	55.4
T ₃	Soil + FYM + cocopeat (1:1:3)	66.50	18.87	60.1
T ₄	Soil + FYM + vermicompost (1:2:1)	77.60	19.77	55.4
T ₅	Soil + vermicompost (1:1)	61.23	17.60	56.8
T ₆	Soil + FYM + vermicompost (1:1:1)	78.57	18.97	58.8
T ₇	Soil + FYM + vermicompost (2:2:2)	83.33	19.17	54.7
T ₈	Soil + FYM (2:2)	77.53	18.30	69.4
T ₉	Soil + vermicompost (2:2)	88.80	21.18	69.7
F-Test		S	S	S
S.Ed (+)		0.11	1.07	0.67
C.D. at 5%		0.32	2.24	1.42

Table 3. Effect of potting media on Leaf Length, Stem Diameter of jackfruit

Treatment Notion	Leaf Length (cm)			Stem Diameter (mm)		
	30DAYS	60DAYS	90DAYS	30DAYS	60DAYS	90DAYS
T ₀	1.5	6.6	11.3	0.3	0.5	1.4
T ₁	1.3	4.7	10.6	0.2	0.2	0.8
T ₂	1.4	7.7	13.1	0.4	0.7	1.1
T ₃	1.8	5.1	11.4	0.4	0.6	1.1
T ₄	1.4	6.9	13.2	0.5	0.6	1.5
T ₅	1.6	7.4	12.9	0.5	0.7	1.7
T ₆	1.9	6.8	11.9	0.6	0.7	1.4
T ₇	1.5	7.1	12.3	0.5	0.7	1.7
T ₈	1.9	6.6	13.2	0.5	0.7	1.2
T ₉	2.1	7.8	14.1	0.7	0.9	1.7
F-Test	S	S	S	S	S	S
S.Ed (±)	0.12	0.19	0.11	0.08	0.10	0.15
C.D. at 5%	0.56	0.14	0.22	0.18	0.21	0.31
C.V	9.28	4.24	1.04	20.75	19.64	13.64

Height of seedlings, Number of leaves on seedlings all showed in the data (Table 3). Result on potting media indicated that T₁ (soil + FYM + cocopeat) recorded the minimum height of seedlings in 30 days (4.2cm), 60 days (14.8cm)

and in 90 days (21.2cm) respectively where as T₉ (soil + vermicompost) was found to be maximum height of seedlings 30 days (11.4cm), 60 days (23.5cm) and in 90 days (25.1cm) respectively.

Table 4. Effect of potting media on Height of seedlings, Number of leaves on leaves on jackfruit seedlings

Treatment Notion	Height of seedlings (cm)			Number of leaves on seedlings		
	30DAYS	60DAYS	90DAYS	30DAYS	60DAYS	90DAYS
T ₀	4.7	15.1	22.2	1.3	3.5	5.4
T ₁	4.2	14.8	21.2	1.2	2.8	4.5
T ₂	7.3	20.6	22.3	1.4	3.7	6.2
T ₃	10.5	19.4	23.6	1.4	3.9	5.6
T ₄	7.9	20.4	25.1	1.5	3.1	5.3
T ₅	7.3	20.3	22.8	1.3	3.9	5.2
T ₆	10.1	20.2	23.3	1.4	3.8	6.1
T ₇	8.6	20.9	24.2	1.5	3.7	5.9
T ₈	7.1	22.1	22.1	1.2	3.1	5.3
T ₉	11.4	23.5	25.1	1.7	4.07	6.3
F-Test	S	S	S	S	S	S
S.Ed (±)	1.07	0.25	0.19	0.12	0.27	0.21
C.D. at 5%	2.24	0.53	0.59	0.25	0.56	0.41
C.V	6.69	1.57	1.48	10.27	9.28	4.24

Table 5. Total cost of cultivation, Gross return, net return and B:C ratio of jackfruit seedlings

Treatment	Fixed cost (Rs)	Variabe cost (Rs)	Total cost of cultivation/1000 polybags	Selling price (Rs)	Gross return (Rs)	Net return (Rs)	B:C
T ₀	4650	0	10398	50	22200	11802	2.13
T ₁	4650	70	10174	53	20664	10390	2.02
T ₂	4650	140	19213	55	49710	20447	2.06
T ₃	4650	160	17197	55	36630	19433	2.13
T ₄	4650	110	20537	55	42735	22198	2.08
T ₅	4650	120	16191	57	34827	18636	2.15
T ₆	4650	110	19092	57	41154	22062	2.14
T ₇	4650	160	22259	58	48314	26055	2.17
T ₈	4650	170	20806	58	45066	24260	2.16
T ₉	4650	180	23828	60	53280	29452	2.23

Result on potting media indicated that T1 (soil + FYM + cocopeat) recorded the minimum number of leaves on seedlings in 30 days (1.2), 60 days (2.8) and in 90 days (4.5) respectively whereas T₉ (soil + vermicompost) was found to be maximum number of leaves on seedlings in 30 days (1.7), 60 days(4.07) and in 90 days (6.3) respectively.

Higher number of leaves per plant and height of plant is might be due to invigoration of physiological process of plants by help of vermicompost to form new leaves at faster rates and thus increased vegetative growth that could have attributed to higher metabolic activities, enhanced growth and better aeration. And the potting media was vermicompost it helps in stem diameter by the nutrition get from vermicompost [18].

Total cost of cultivation, Gross return, net return and B:C ratio seedlings all showed in the data

(Table 4) Result on potting media indicated that Benefit cost ratio for making 1000 polybag for T1 (Soil + FYM + cocopeat) is low (2.02) hence giving less return but T₉ (soil + vermicompost) is high (2.23) with high returns.

T1 Soil + FYM + cocopea (3:1:1) has the lowest B:C ratio (2.02) in comparison with rest of treatments. But the T₉ has the best B:C ratio (2.23) in comparison with others respectively.

4. CONCLUSION

From the present investigation it is concluded that treatment T₉ (Soil + vermicompost) performed best in terms of germination %, number of day to germinate, leaves per plant, height of seedlings, leaf length, stem diameter, chlorophyll content, and in economic difference of jackfruit seedling under Pryagraj agro-climatic condition.

The maximum benefit cost ratio was observed in the same treatment with 2:2.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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