



Effect of Different Growing Media on Seed Germination, Seedling Growth and Establishment of Papaya (*Carica papaya* L.) cv. Red Lady

Mukesh Kumawat ^{a++*} and Samir E. Topno ^{a#}

^a Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JABB/2024/v27i5858

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/116576>

Original Research Article

Received: 25/02/2024
Accepted: 29/04/2024
Published: 02/05/2024

ABSTRACT

The study was carried out to study Effect of Different Growing Media on Seed Germination, Seedling Growth and Establishment of Papaya (*Carica papaya* L.) cv. Red Lady during 2023-24. They were utilized for research in order to facilitate seed germination and seedling growth on various media. The current study used a randomized block design with three replications for each of the nine treatment combinations. The characteristics of seed germination and the growth parameters of seedlings were noted. The findings demonstrated that utilizing a medium mixture consisting of soil, vermicompost, and cocopeat (1:2:1) improved seed germination (91.93%) and reduced days of germination (14.73). The highest net profit ratio (Rs. 323227.5 per 1000 seedlings) and B:c ratio (3.47) of seedlings were observed in the maximum seedling height (13.20 cm),

⁺⁺ M. Sc. Scholar;

[#] Assistant Professor;

*Corresponding author: E-mail: mk6257384@gmail.com;

number of leaves (13.40), chlorophyll content (67.85), shoot length (9.62 cm), girth of seedling (5.74 mm), Seedling Vigor index (1213.75), fresh weight of seedling (18.98 g), leaf area (46.05 cm²), and seedling survival percentage (83.27%).

Keywords: Germination; seedling growth; red lady; papaya.

1. INTRODUCTION

The papaya (*Carica papaya* L.), sometimes known as the "wonder fruits of the tropics," is an important tropical fruit crop. As a member of the Caricaceae family, it was brought to India in the 16th century from Malacca, where it originated in Tropical America [1]. grown papayas in a variety of biological forms, including monoecious, dioecious, and gynodioecious varieties [2].

A lower survival rate for papaya plants can be attributed to a number of factors, including initial mortality and inadequate germination. The success of fruit production can be ensured by using high-quality papaya seedlings to create plants with high genetic potential [3]. A strong, evenly distributed root system, a low relationship between the shoot and root phytomass, and adequate formation are all related to the quality of seedlings [4,5]. The growth and maintenance of a robust, functional root system are directly impacted by the choice of growing media, which is crucial for the creation of healthy plants. The type of media utilized affects the seedlings' quality [6].

These states' topography and climate are perfect for producing high-quality papaya. Papaya fruits get their yellow to orange color from caricaxanthin. It is a sweet and refreshing fruit that is widely prized for its ability to aid with digestion. Meena et al. [7] further argued that because papaya juice contains lycopene and caricaxanthin, it also functions as an in vitro antiproliferative against liver cancer cells. Papayas can lower your risk of cancer, diabetes, and heart disease when you eat them regularly. The strong therapeutic value of papain is extracted from ripe papayas and is also utilized as an industrial ingredient in tanning, cosmetic, optical, and brewing products [8-9].

2. MATERIALS AND METHODS

2.1 Study Location

The fieldwork was carried out in the Prayagraj district, which is located in a semi-arid, subtropical zone with extremes of temperature, namely winter and summer. The region Recorded data on growth parameters were made at transplantation (45 days post-sowing). Stem

experiences occasional lows of 4°–5°C and maximum temperatures of 46°–48°C. There is a 20% to 94% variation in relative humidity. In this area, there is typically 900–1100 mm of rainfall per year. Throughout the crop season, 5.9°C was to be the lowest temperature and 29.04°C was to be the highest. Maximum humidity levels were 42.72% and 93.28%, respectively.

2.2 Layout and Treatment Combination

Research on the growth of seeds and seedlings of the papaya variety Red Lady was done during 2023-2024 at the Horticultural Research Facility of Naini Agricultural Institute, SHUATS, Prayagraj, (Uttar Pradesh). The experiment was set up at nine levels in RBD viz. Media. T₀: control, T₁: Soil + FYM (1:1), T₂: Soil + Cocopeat (1:1), T₃: Soil + Vermicompost (1:1), T₄: Soil + FYM + Cocopeat (1:1:1), T₅: Soil + FYM + Vermicompost (1:1:1), T₆: Soil + FYM + Cocopeat (1:2:1), T₇: Soil + Vermicompost + Cocopeat (1:2:1) and T₈: Soil + FYM + Cocopeat + Vermicompost (1:1:1:1). The seed sowing was done in 18/03/2023 about 2 cm depth in different containers with different media as per the treatments.

2.3 Methods for Different Parameters

From the start germination until there was no more germination, two days' worth of observations on the germination parameters were made. For every treatment, the imbibition period—the number of days from seeding to the start of germination—was noted. The number of seedlings that germinated divided by the total number of seeds put in containers multiplied by 100 was used to calculate the germination percentage. The difference (in days) between the first and final emergence was used to compute the germination duration. The seed vigor was determined to be:

$$\text{Seed vigor} = \frac{\text{Total number of healthy seedling}}{\text{Total number of seedling}} * 100$$

girth was measured with a Vernier caliper, and seedling height was measured using a metric

scale, which measured the distance from the plant collar to the apex of the plant. After the real leaves appeared, the number of leaves was counted. Using a leaf area meter model number EMP-171492, the leaf area was determined. Plant uprooting allowed for the measurement of root length. (Gupta 1993): The seed vigour index was computed as follows:

$$\text{Seed vigour index} = \text{Germination percent} \times \text{seedling length}$$

The proportion of seeds that germinated was determined by dividing the total number of seeds seeded in polybags by the number of sprouted seeds, then multiplying the result by 100. The difference in number of days between the initial and ultimate emergence was used to compute the germination duration. By dividing the total number of healthy seedlings by the total number of seedlings and multiplying the result by 100, the seed vigor was determined. According to the Association of Official Seed Analysis (1983), the germination index was computed using the following formula:

$$\text{Germination index} = \frac{(\text{No of germination seeds}) / (\text{Days of first count}) + (\text{No of germination seeds}) / (\text{Days of final or last count})}{1}$$

Survival percent was recorded as:

$$\text{Survival percent} = \frac{(\text{Total Survival transplant plants})}{(\text{Total transplant plants})} \times 100$$

To find significant differences and compare means at a 5% significance level, all data were submitted to an analysis of variance (ANOVA).

3. RESULTS AND DISCUSSION

3.1 Germination Parameters

3.1.1 Days to germination

The Days to germination among the different treatments differed significantly. The treatment T₇ Soil + Vermicompost + Cocopeat (1:2:1) recorded maximum Days to germination (14.73). Whereas the minimum Days to germination (20.53) was recorded in the treatment T₀ Control.

3.1.2 Germination percentage

The Germination percentage among the different treatments differed significantly. The treatment T₀ Control recorded minimum Germination percentage (70.93). Whereas the maximum Germination percentage (91.93) was recorded in the treatment T₇ Soil + Vermicompost + Cocopeat (1:2:1).

3.2 Growth Parameters

3.2.1 No. of leaves

The No. of leaves among the different treatments differed significantly. The treatment T₀ control minimum No. of leaves (8.00). Whereas the maximum No. of leaves (13.40) was recorded in the treatment T₇ Soil + Vermicompost + Cocopeat (1:2:1).

3.2.2 Shoot length (cm)

The Shoot length (cm) among the different treatments differed significantly. The treatment T₇ Soil + Vermicompost + Cocopeat (1:2:1) maximum Shoot length (cm) (9.62). Whereas the minimum Shoot length (cm) (7.85) was recorded in the treatment T₀ Control.

3.2.3 Seedling height (cm)

The Seedling height (cm) among the different treatments differed significantly. The treatment T₇ Soil + Vermicompost + Cocopeat (1:2:1) recorded maximum Seedling height (cm) (13.20). Whereas the minimum Seedling height (cm) (11.43) was recorded in the treatment T₀ Control.

3.2.4 Grith of seedling (mm)

The Grith of seedling (mm) among the different treatments differed significantly. The treatment T₀ control recorded minimum Grith of seedling (mm) (3.44). Whereas the maximum Grith of seedling (mm) (5.75) was recorded in the treatment T₇ Soil + Vermicompost + Cocopeat (1:2:1).

3.2.5 Seedling vigour index

The Seedling vigour index among the different treatments differed significantly. The treatment T₀ control recorded minimum Seedling vigour index (811.00). Whereas the maximum Seedling vigour index (1213.75) was recorded in the treatment T₇ Soil + Vermicompost + Cocopeat (1:2:1).

3.2.6 Fresh weight of seedling (g)

The Fresh weight of seedling (g) among the different treatments differed significantly. The treatment T₇ Soil + Vermicompost + Cocopeat (1:2:1) recorded maximum Fresh weight of seedling (g) (18.98). Whereas the minimum Fresh weight of seedling (g) (12.05) was recorded in the treatment T₀ Control.

Table 1. Germination efficacy against different treatment combinations

Treatment	Treatment combination	Days to Germination	Germination (%)	No. of leaves	Chlorophyll content	Seedling vigor index	Fresh Weight of Seedling (g)	Leaf area (cm ²)	Survivability (%)
T0	Control	20.53	70.93	8.00	29.56	811.00	12.05	32.53	47.27
T1	Soil + FYM (1:1)	16.53	79.73	10.60	32.67	956.42	13.74	37.16	53.27
T2	Soil + Cocopeat (1:1)	16.73	78.53	10.20	35.46	947.57	14.67	42.63	58.27
T3	Soil + Vermicompost (1:1)	18.53	72.13	10.00	40.35	879.87	15.07	39.07	65.27
T4	Soil + FYM + Cocopeat (1:1:1)	19.53	72.73	10.60	46.19	895.76	15.39	40.83	71.27
T5	Soil + FYM + Vermicompost (1:1:1)	13.73	89.33	12.80	56.82	1168.37	18.05	44.66	81.27
T6	Soil + FYM + Cocopeat (1:2:1)	18.53	72.73	10.20	42.38	919.04	16.63	41.87	74.27
T7	Soil + Vermicompost + Cocopeat (1:2:1)	14.73	91.93	13.40	67.85	1213.75	18.98	46.05	83.27
T8	Soil +FYM+Cocopeat +Vermicompost (1:1:1:1)	17.53	82.53	9.40	47.95	1062.80	15.83	40.27	78.27
F-Test		S	S	S	S	S	S	S	S
S.Ed(±)		1.34	1.89	0.38	2.36	64.26	1.18	1.32	2.84
CD@5%		2.68	3.98	0.89	4.52	128.65	2.35	2.68	5.68
CV		4.67	4.38	1.24	7.87	241.78	4.46	5.236	7.98

Table 2. Shoot efficacy against different treatment combinations

Treatment	Treatment combination	Shoot Length (cm)			Seedling Height (cm)			Seedling girth (mm)		
		15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS
T0	Control	2.22	4.28	7.85	3.53	7.60	11.43	1.58	2.37	3.44
T1	Soil + FYM (1:1)	2.78	4.84	8.41	4.09	8.16	11.99	1.98	2.75	3.84
T2	Soil + Cocopeat (1:1)	2.86	4.92	8.49	4.17	8.24	12.07	2.18	2.95	4.04
T3	Soil + Vermicompost (1:1)	3.00	5.06	8.63	4.31	8.38	12.21	2.48	3.25	4.34
T4	Soil + FYM + Cocopeat (1:1:1)	3.10	5.16	8.73	4.41	8.48	12.31	1.98	2.75	3.84
T5	Soil + FYM + Vermicompost (1:1:1)	3.86	5.92	9.49	5.17	9.24	13.07	3.48	4.25	5.34
T6	Soil + FYM + Cocopeat (1:2:1)	3.42	5.48	9.05	4.73	8.80	12.63	2.68	3.45	4.54
T7	Soil + Vermicompost + Cocopeat (1:2:1)	3.99	6.05	9.62	5.30	9.37	13.20	3.88	4.65	5.74
T8	Soil +FYM+Cocopeat +Vermicompost (1:1:1:1)	3.66	5.72	9.29	4.97	9.04	12.87	1.78	2.55	3.64
F-Test		S	S	S	S	S	S	S	S	S
S.Ed(±)		0.27	0.41	0.34	0.12	0.12	0.31	0.43	0.42	0.41
CD@5%		0.56	0.87	0.75	0.24	0.25	0.62	0.87	0.85	0.83
CV		0.89	1.65	1.24	0.46	0.46	1.25	1.67	1.58	1.59

Table 3. Seedling efficacy against different treatment combinations

Treatment	Treatment combination	No. of papaya seedling /100m (Rs.)	Selling price /seedling(Rs.)	Gross return(Rs.)	Net Return (Rs.)	B C: ratio
T0	Control	4727	5	23635	14877.5	1.70
T1	Soil + FYM (1:1)	5327	5	26635	17777.5	2.01
T2	Soil + Cocopeat (1:1)	5827	5	29135	20077.5	2.22
T3	Soil + Vermicompost (1:1)	6527	5	32635	23627.5	2.62
T4	Soil + FYM + Cocopeat (1:1:1)	7127	5	35635	26477.5	2.89
T5	Soil + FYM + Vermicompost (1:1:1)	8127	5	40635	31527.5	3.46
T6	Soil + FYM + Cocopeat (1:2:1)	7427	5	37135	27877.5	3.01
T7	Soil + Vermicompost + Cocopeat (1:2:1)	8327	5	41635	32327.5	3.47
T8	Soil +FYM+Cocopeat +Vermicompost (1:1:1:1)	7827	5	39135	29727.5	3.16

3.2.7 Leaf area

The Leaf area among the different treatments differed significantly. The treatment T₀ control recorded minimum Leaf area (32.53). Whereas the maximum Leaf area (46.05) was recorded in the treatment T₇ Soil + Vermicompost + Cocopeat (1:2:1).

3.3 Survival and Establishment

3.1 Survival Percentage

The Survival percentage among the different treatments differed significantly. The treatment T₇ Soil + Vermicompost + Cocopeat (1:2:1) recorded maximum Survival percentage (83.27). Whereas the minimum Survival percentage (47.27) was recorded in the treatment T₀ Control.

3.4 Economics

Because of the higher germination and survival rates attained (Tables 1 and 3), the application of Soil + Vermicompost + Cocopeat (1:2:1) with 2 cm cocopeat media (T₇) for the preparation of papaya seedling proved profitable and showed maximum net return (Rs. 32327.5/1000 seedlings) and Benefit:cost ratio (3.47) for the experimentation. The cost-benefit ratio of this treatment was comparable to that of the T₀ treatment, but it was noticeably better than the other therapies during the year.

4. CONCLUSION

The treatment T₇ (Soil + Vermicompost + Cocopeat (1:2:1)) was shown to be optimal in terms of germination %, growth parameters, survival percentage, and papaya establishment, based on the results of our experiments. T₇ (Soil + Vermicompost + Cocopeat (1:2:1)) had the highest B:C ratio, 3.47.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Hafmer A. Papaya. Fruits-Tropical and Subtropical, Naya Prakash. 1990;497.
2. Ray PK. Breeding of tropical and subtropical fruits. Springer Science and Business Media. 2002;548-556.
3. Albano FG, Marques AS, Cavalcante IHL. Alternative substrate for the production of papaya *formosa* seedlings (cv. Caliman). Scientific Journal. 2014; 42(4):388–95.
4. Costa E, Dias JG, Lopes KG, Binotti FFS, Cardoso ED. Shading screens and substrates in the production of seedlings of *Dipteryx alata* Vog. Forest and Environment Magazine. 2015;22(3):416–25.
5. Sanches CF, Costa E, Costa GGS, Binotti FFS, Cardoso ED. Hymenaea coubaril seedlings in protected environments and substrates. Agricultural Engineering. 2017;37(1):24–34.
6. Wilson SB, Stoffella PJ, Graetz DA. Use of compost as a media amendment for containerized production of two subtropical perennials. Journal of Environmental Horticulture. 2001;19:34–42.
7. Meena AK, Garhwal OP, Mahawar AK, Singh SP. Effect of different growing media on seedling growth parameters and economics of papaya (*Carica papaya* L.) cv. Pusa delicious. Int J Curr Microbiol App Sci. 2017;6(6):2964-2972.
8. Dayeswari D, Auxcilia J, Malarkodi K, Vijayakumar RM. Effect of Chemicals and Bio-Inoculants on Seedling Growth and Vigour of TNAU Papaya CO. 8 (*Carica papaya* L.). Int. J Curr. Microbiol. App. Sci, 2018;7(3):3007-3014.
9. Effect of Different Growing Media on Seed Germination, Seedling Growth and Establishment of Papaya (*Carica papaya* L.) cv. Red Lady during 2023-24.

© Copyright (2024): Author(s). The licensee is the journal publisher. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/116576>