International Journal of Agriculture and Food Science 2025; 7(7): 319-322

ISSN Print: 2664-844X
ISSN Online: 2664-8458
NAAS Rating: 4.97
IJAFS 2025; 7(7): 319-322
www.agriculturaljournals.com
Received: 25-05-2025
Accepted: 27-06-2025

Hariwinsrimedha RS
Department of Fruit Science, SRM College of Agricultural Sciences, SRM Institute of Science and Technology, Baburayanpettai, Chengalpattu, Tamil Nadu, India

B Gopu
Department of Fruit Science, SRM College of Agricultural Sciences, SRM Institute of Science and Technology, Baburayanpettai, Chengalpattu, Tamil Nadu, India

A Akino
Department of Fruit Science, SRM College of Agricultural Sciences, SRM Institute of Science and Technology, Baburayanpettai, Chengalpattu, Tamil Nadu, India

S Rageshwari
Department of Plant Protection, SRM College of Agricultural Sciences, SRM Institute of Science and Technology, Baburayanpettai, Chengalpattu, Tamil Nadu, India

S Shanmugam
Department of Computing Technologies, Faculty of Engineering and Technology, SRM Institute of Science and Technology, Kattankulathur, Chengalpattu, Tamil Nadu, India

Corresponding Author:
B Gopu
Department of Fruit Science, SRM College of Agricultural Sciences, SRM Institute of Science and Technology, Baburayanpettai, Chengalpattu, Tamil Nadu, India

Exploring the impact of different rooting media on the growth and development of protray grown papaya (*Carica papaya* L.) var. Red Lady

Hariwinsrimedha RS, B Gopu, A Akinod, S Rageshwari and S Shanmugam

DOI: https://www.doi.org/10.33545/2664844X.2025.v7.i7d.524

Abstract
This study investigates the effect of various rooting substrates on the growth and development of Pro-tray grown papaya (C*arica papaya* L). var. Red Lady under nursery conditions. The objective was to screen the most suitable rooting media in seedlings for better vigour, uniform growth and high survival percentage after transplantation, which will ultimately provide an advantage for higher productivity and early fruiting. Five different rooting medium constitutions, *viz*., cocopeat + vermicompost, cocopeat + vermicompost + *Trichoderma asperellum* and soil + sand + farmyard manure (FYM), were applied to the plots laid out in a Complete randomized design with four replications. Compared with other media, the highest seedling height, stem diameter, and root length were observed in cocopeat + vermicompost + *Trichoderma asperellum*. This medium provided the best aeration and water retention as well as the highest nutrient accessibility required for early and aggressive root establishment. The control (soil + sand + FYM), on the other hand, gave less uniform root development, having probably become compacted and non-uniform in moisture content. These results can be useful to commercial papaya growers and nursery managers for choosing rooting media that will improve seedling quality.

Keywords: *Carica papaya*, Red Lady, rooting media, pro-tray nursery, seedling growth

Introduction

Papaya (*Carica papaya* L.) is an economically important tropical fruit crop due to its nutritional, medicinal and commercial value. Among the different cultivars of papaya, the Red Lady is considered to be preferred with better offering of early fruiting, high yielding and superior fruit quality. Nevertheless, healthy seedling transplants are necessary to achieve successful production, and this is strongly influenced by the nursery stage, especially the type of rooting medium. Rooting media not only supports the seedling physically, but it also provides water, air and nutrients necessary to get a uniform and vigorous growth of seedlings (Pant and Verma, 2022) [11].

From the old school nursery beds to today's practice of pro-tray, the journey for the production of uniform, pest-free seedlings has been truly revolutionary. Pro-trays, along with scientifically developed root media, can be a useful tool for enhancing the survival of transplants in the nursery as well as early field establishment (Suthar and Gairola, 2021) [18]. Cocopeat is a popular medium amongst other media because of its high water holding capacity and high porosity. It is usually mixed with other inert or organic amendments such as perlite, vermiculite, or vermicompost to increase nutrient retention, aeration and microbial activity (Abad *et al.*, 2001) [1]. The choice and optimisation of these media combinations are important for prompt root initiation, vigorous shoot growth, and their overall seedling vigour. Growing media not only acts as a growing place but also as a source of nutrients for seedling growth (Gopu *et al.*, 2022) [4].

Other researchers have pointed out that substrate composition is an essential factor for seedling performance in varying species of crops. Similarly, Singh *et al.* (2014) [14], papaya seedlings that were raised in based media performed better than those raised in normal soil media. Nevertheless, there have been few systematic investigations conducted on papaya var. Red Lady under nursery conditions of pro-tray, particularly incorporating quantitative assessment methods. Singh *et al.* (2014) [14] observed improvements in germination percentage, seedling height, and roots due to the use of cocopeat-based media in papaya. The authors recommended the use of cocopeat in conjunction with vermicompost rather than soil-based media, citing the former's superior aeration and water retention capabilities. However, the findings of Kumar and Rani (2016) [7] reported that in high humidity conditions, cocopeat resulted in excessive retention of moisture, leading to root rot and poor seedling vigour, indicating the necessity of media selection under the context of climate.

Patel *et al.* (2019) [12] proved that the biomass accumulation and root-to-shoot ratio of Red Lady papaya seedlings were higher when the medium of a mixture of cocopeat, vermicompost and perlite soil in a ratio of 1:1:1, under greenhouse conditions. Nevertheless, Ravi *et al.* (2020) [13] reported that these blends are costlier and therefore may not be affordable for smallholder farmers even if such blends are effective. Pro-trays, along with light aerated media, were recommended to reduce transplanting shock in the papaya (Kumar and Jaya, 2024) [6]. Srinivas and Mohan (2024) [16] reported that field soil acclimatization is more effective when seedlings are cultivated in a partially soil-based medium, resulting in lowered post-transplant mortality. Against this background, any beneficial effects of rooting media will help to narrow down the gap and thus constitute an incentive for this study, which assessed the influence of various rooting media on the growth and development of pro-tray raised papaya cv. Red Lady.

Materials and Methods

The experiment was conducted at the nursery of SRM College of Agricultural Science, located in the peaceful area of Vendhar Nagar, Baburayanpettai, Chengalpattu, Tamil Nadu. The primary aim of this study was to investigate the effects of different growing media on seed germination, growth, and development of pro-tray-grown papaya var. Red Lady. To achieve reliable and valid results, a complete randomized design was utilised, featuring five distinct treatment groups, each replicated four times. This design allowed for a thorough analysis of each treatment's impact while minimising biases. For each replication, a pro-tray was employed for seedling cultivation.

The treatments explore various media compositions are T_1: Control - Red Earth (50%) + Sand (25%)+ FYM (25%), T_2: Red Soil (25%) + Cocopeat (25%) + Vermicompost (50%), T_3: Red Soil (25%) + Cocopeat (50%) + Vermicompost (25%), T_4: Red Soil (25%) + Cocopeat (25%) + Vermicompost (50%) + *Trichoderma asperellum*, T_5: Red Soil (25%) + Cocopeat (50%) + Vermicompost (25%) + *Trichoderma asperellum.* Before sowing the seeds into the pro-tray, they were treated with gibberellic acid (GA_3) at a concentration of 200 ppm for 12 hours. The mixing of the growing media followed precise guidelines: each component was measured according to the specified ratios and thoroughly combined to ensure homogeneity. This mixture was then carefully filled into the pro-tray one day before planting. The seed sowing was done in January (2025) about 1 cm deep in a pro-tray as per the treatments. These pro-trays are watered immediately after sowing with the help of a rose can and maintained medium moisture level throughout the study period.

Observation on germination parameters was recorded. The days taken for first sprouting, number of days taken for germination, germination percentage of seedlings, seedling height at 45^{th} day (cm), seedling girth (mm), number of leaves, fresh weight of shoot (g), fresh weight of root (g), dry weight of shoot (g), dry weight of root (g) and vigour index (%) were recorded. The results from the experiment were statistically analyzed using the General R-Based Analysis Platform Empowered by Statistics (GRAPES), developed by the Department of Agricultural Statistics, Kerala Agricultural University, Kerala (www.kaugrapes.com). Analysis of Variance (ANOVA) was performed to compare the means, using a significance level of $P \leq 0.05$.

Results and Discussion

In this study, the data presented in Tables 1 to 3 unequivocally demonstrate the significant impact of various observations, on growth parameters such as seedling height, girth, number of leaves, fresh weight of shoots and roots, dry weight of shoots and roots, germination percentage, vigour index, number of days to germination and days until first sprouting. The investigation decisively evaluated the effects of different growing media combinations, including the beneficial fungus *Trichoderma asperellum*, on the seedling performance of papaya cv. Red Lady. The results indicate significant differences among the treatments for all observed parameters, emphasising the essential role of organic amendments and microbial inoculants in enhancing seedling growth.

Effect of growing media on germination percentage of seedlings (%), days taken for first sprouting, number of days taken for germination and vigour index (%) in papaya cv. Red Lady

In the present study, the highest germination percentage (96%) was recorded in T_4, followed by the control (94%), while T_3 and T_5 recorded the lowest germination percentage (88%) (Table 1.). It might have provided more uniform and congenial conditions for seed germination. The T_4 treatments, Red Soil (25%) + Cocopeat (25%) + Vermicompost (50%) + *Trichoderma asperellum* combinations, provide a uniform physical structure that ensures close contact between seeds and media, increases balanced moisture supply, and facilitates better germination when compared with other treatments. Similar results were also reported by Bhardwaj (2014), Arvind *et al.* (2015) and Pant and Verma (2022) [3, 2, 11] in papaya seedlings. Among the different treatments, the lowest days taken for first sprouting and the number of days taken for germination were recorded as T_4, T_2 and T_1. However, the treatments T_3 and T_5 recorded the maximum days (Table 1). Better germination traits could be attributed to less evaporation of moisture from the protrays ultimately provides congenial conditions for fast germination. Similar results were obtained by Pant and Verma (2022) [11] in papaya cv. Red Lady. It is observed that the highest number of days for the first sprouting and the number of days taken for germination are recorded in the cocopeat (50%) combinations. So, excess cocopeat in the media combinations delayed the germination. Although the treatment T_5 had relatively lower germination, its seedling vigour index was highest, indicating superior seedling quality. The significant increase in vigour index under *Trichoderma* treatments suggests its role in promoting overall seedling health, as previously observed by Montalvao *et al.* (2020) [10] in tomato seedlings. These results indicate that integrating *Trichoderma* and organic media components creates favourable conditions for early growth stages.

Table 1: Effect of growing media on germination percentage of seedlings (%), days taken for first sprouting, number of days taken for germination and vigour index (%) in papaya cv. Red Lady

Treatment Details	Germination percentage of seedlings (%)	Days taken for the first sprouting	Number of days taken for germination	Vigour index (%)
T_1: Control (Red Earth: Sand: FYM)	94	3	6	1457.00
T_2: Red Soil (25%) + Cocopeat (25%) + Vermicompost (50%)	92	3	6	1403.00
T_3: Red Soil (25%) + Cocopeat (50%) + Vermicompost (25%)	88	4	8	1673.70
T_4: Red Soil (25%) + Cocopeat (25%) + Vermicompost (50%) + *Trichoderma asperellum*	96	3	6	1552.30
T_5: Red Soil (25%) + Cocopeat (50%) + Vermicompost (25%) + *Trichoderma asperellum*	88	4	8	1738.00
SEd	1.02	0.041	0.128	17.14
CD (0.05)	2.18	0.088	0.272	36.53

Effect of growing media on seedling height at 45th day (cm), seedling girth (cm) and number of leaves in papaya cv. Red Lady

A critical factor in enhancing seedling growth attributes is plant nutrition (Suresh *et al.*, 2023) [17]. The maximum seedling height (19.75 cm) was observed in T_5 (Red Soil 25% + Cocopeat 50% + Vermicompost 25% + *Trichoderma asperellum*), followed by T_3 (19.02 cm), which contained a similar substrate composition without *Trichoderma*. The control (T_1) recorded 15.25 cm, indicating that media enriched with cocopeat and vermicompost significantly improved the seedling height. It suggests that cocopeat played a major role in vertical height. These findings align with Kumawat and Topno (2024) [8], who reported that cocopeat and vermicompost combinations enhance water retention and aeration, resulting in better seedling elongation. Seedling girth was significantly higher in T_4 (2.48 mm), where *Trichoderma asperellum* was incorporated, compared to the control (1.66 mm). This suggests that *Trichoderma* inoculation improves nutrient uptake and promotes cell expansion, consistent with the work of Maurya *et al.* (2020) [9] in tomato seedlings, who emphasised the role of beneficial microbes in boosting seedling growth robustness**.** This indicates the role of nutrient-rich compost and better microflora for improving the structural components of the plants. The number of leaves per seedling was highest in T_4 and T_5 (7.6 leaves), significantly higher than the control (6.2 leaves). Increased number of leaves under *Trichoderma* treatments may be due to improved root activity and nutrient availability (Pant and Verma, 2022) [11].

Table 2: Effect of growing media on seedling height at 45th day (cm), seedling girth (cm) and number of leaves in papaya cv. Red Lady

Treatment Details	Seedling height at 45th day (cm)	Seedling girth (mm)	Number of leaves
T_1: Control (Red Earth: Sand: FYM)	15.25	1.66	6.2
T_2: Red Soil (25%) + Cocopeat (25%) + Vermicompost (50%)	15.50	2.14	7.2
T_3: Red Soil (25%) + Cocopeat (50%) + Vermicompost (25%)	19.02	1.78	6.8
T_4: Red Soil (25%) + Cocopeat (25%) + Vermicompost (50%) + *Trichoderma asperellum*	16.17	2.48	7.6
T_5: Red Soil (25%) + Cocopeat (50%) + Vermicompost (25%) + *Trichoderma asperellum*	19.75	1.88	7.6
SEd	0.290	0.130	0.070
CD (0.05)	0.617	0.277	0.150

Effect of growing media on fresh weight of shoot (g), fresh weight of root (g), dry weight of shoot (g) and dry weight of root (g) in papaya cv. Red Lady

Regarding biomass, the treatment T_4 showed the highest fresh shoot weight (1.74 g) and dry shoot weight (0.44 g), along with increased root biomass (0.16 g fresh and 0.12 g dry weight). These findings support earlier reports by Singh *et al.* (2016) [15] in pea, highlighting the growth-promoting effects of *Trichoderma* through enhanced root development and soil health improvement**.** These findings align with the research findings of Hazarika *et al.* (2023) and Bhardwaj (2014) [5, 3] in papaya for the use of cocopeat and vermicompost media combinations.

Table 3: Effect of growing media on fresh weight of shoot (g), fresh weight of root (g), dry weight of shoot (g) and dry weight of root (g) in papaya cv. Red Lady

Treatment Details	Fresh weight of shoot (g)	Fresh weight of root (g)	Dry weight of shoot (g)	Dry weight of root (g)
T_1: Control (Red Earth: Sand: FYM)	1.14	0.10	0.10	0.05
T_2: Red Soil (25%) + Cocopeat (25%) + Vermicompost (50%)	1.58	0.15	0.33	0.09
T_3: Red Soil (25%) + Cocopeat (50%) + Vermicompost (25%)	1.20	0.11	0.14	0.09
T_4: Red Soil (25%) + Cocopeat (25%) + Vermicompost (50%) + *Trichoderma asperellum*	1.74	0.16	0.44	0.12
T_5: Red Soil (25%) + Cocopeat (50%) + Vermicompost (25%) + *Trichoderma asperellum*	1.23	0.11	0.16	0.06
SEd	0.015	0.002	0.005	0.002

CD (0.05)	0.031	0.003	0.011	0.005

Conclusion

This investigation systematically examined the influence of different rooting substrates on the growth and development of papaya var. Red Lady is produced in a pro-tray system. Based on the experiment, it is concluded that treatments T_4 and T_5 were the most effective, enhancing growth parameters such as germination percentage, vigour index, and root and shoot characteristics. Among the treatments, T_4 and T_5 demonstrated the best overall performance in promoting seedling growth and establishment of protrays grown papaya cv. Red Lady.

References

1. Abad M, Noguera P, Bures S. National inventory of organic wastes for use as growing media for ornamental potted plant production: case study in Spain. Bioresour Technol. 2001;77(2):197-200.
2. Arvind RK, Patel KM, Upadhyay NV. Effect of different growing media and containers on germination and establishment of seedlings of papaya (*Carica papaya* L.) cv. Madhubindu. Trends Biosciences. 2015;8(1):227-230.
3. Bhardwaj RL. Effect of growing media on seed germination and seedling growth of papaya cv. Red Lady. Afr J Plant Sci. 2014;8(4):178-184.
4. Gopu B, Mathankumar R, Kumaresh R, Kanimozhi C. Standardization of Growing Media for Palak (*Beta vulgaris* var. *bengalensis*) var. Arka Anupama under Shade Net Conditions. Eco Env Cons. 2022;28(August Suppl. Issue):S315-S319.
5. Hazarika B, Gogoi S, Das RT, Bordoloi A. Studies on seed germination, growth and vigour of papaya seedlings cv. 'Sapna' as influenced by growth regulators and propagation media. Pharma Innovation J. 2023;12(11):2387-2391.
6. Kumar A, Jaya R. Effectiveness of light rooting media in reducing transplant shock in papaya pro-trays. Hortic Technol. 2024;6(1):21-29.
7. Kumar S, Rani P. Influence of growing media on papaya seedling growth under humid tropical conditions. Int J Agric Sci. 2016;8(1):23-28.
8. Kumawat M, Topno SE. Effect of different growing media on seed germination, seedling growth and establishment of papaya (*Carica papaya* L.) cv. Red Lady. J Adv Biol Biotechnol. 2024;27(5):962-967.
9. Maurya S, Rai D, Rai B, Dubey S. Growth promotion effect of *Trichoderma* isolates on tomato seedlings. 2019. p. 115-118.
10. Montalvao SCL, Marques E, Silva JBT, Silva JP, Mello SCM. *Trichoderma* activity in seed germination, promoting seedling growth and rhizocompetence in tomato plants. J Agric Sci. 2020;12(10):252.
11. Pant P, Verma MK. Standardization of media and container for improving seed and seedling growth in papaya (*Carica papaya*) cv. Red Lady. Indian J Agric Sci. 2022;92(3):329-33.
12. Patel D, Sharma H, Singh R. Optimization of media components for vigorous growth of papaya seedlings under greenhouse conditions. J Hortic Res. 2019;27(1):89-94.
13. Ravi P, Kumari L. Economic viability of using locally available nursery media for papaya cultivation. J Agric Ecol. 2020;11(2):112-119.
14. Singh A, Kumar V, Mishra RK. Effect of different growing media on germination and seedling growth of papaya under a net house. Asian J Hortic. 2014;9(2):314-316.
15. Singh V, Upadhyay RS, Sarma BK, Singh HB. Seed bio-priming with *Trichoderma asperellum* effectively modulates plant growth promotion in pea. Int J Agric Environ Biotechnol. 2016;9(3):361-365.
16. Srinivas R, Mohan S. Role of soil-based nursery substrates in improving field establishment of papaya seedlings. Open Agric J. 2024;14(1):58-65.
17. Suresh V, Kousalya R, Gopu B, Kabariel J, Rajkumar A. Standardization of organic manures on growth of winter cherry (*Withania somnifera*). Res J Pharm Tech. 2023;16(12):5593-5596.
18. Suthar M, Gairola S. Application of different rooting media on plant propagation: a review. J Plant Nutr. 2021;44(8):1194-1205.