

Effect of different Types of Media and Containers on Germination, Survival, Growth and Establishment of Papaya (*Carica papaya* L.) cv. Red Lady under Protected Condition

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ABSTRACT: The experiment was conducted to study the “Effect of different types of media and containers on germination, survival, growth and establishment of papaya (*Carica papaya* L.) cv. Red Lady under protected condition” at Hi-tech nursery located at Centre of Excellence on Protected Cultivation and Precision Farming, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh during October to December, 2020. The experiment was setup in five levels of growing media i.e. (M₀) Soil + FYM, (M₁) Soil + FYM + Cocopeat (1:1:1), (M₂) Soil + FYM + Vermicompost (1:1:1), (M₃) Soil + FYM + Sand (1:1:1) and (M₄) Soil + FYM + Poultry manure (1:1:1), (M₅) Soil + FYM + Sand + Vermicompost (1:1:1:1) as well as three containers (C₁) Green Bag, (C₂) Black polybag and (C₃) White polybag. The design used in the experiment was Factorial Complete Randomized Design with combination of 15 treatments and one control, replicated thrice. The results showed that the growing media (M₅) Soil + FYM + Sand + vermicompost (1:1:1:1) was found superior medium for the growth of papaya seedlings as it showed the highest germination and growth parameters in terms of maximum germination (92.02 %) at 30 DAS, maximum height of seedling i.e. 11.28, 13.33 and 14.44 cm at 30, 45 and 60 DAS, respectively, maximum stem diameter 4.48 mm and 5.47 mm at 45, 60 DAS, maximum number of leaves (14.33, 17.00, 20.17) at 30, 45 and 60 DAS, minimum number of days (15.00) required for last sprouting. Further it can be concluded that among the containers, (C₃) – White polybag is worth recommendable as it took minimum days (14.89) taken for initiation of germination, minimum days required for 50 per cent germination (14.13), maximum germination percentage at 30DAS (84.36%), maximum height of seedling (9.26, 10.96 and 12.12 cm), maximum stem diameter (3.96 and 4.85 mm), maximum number of leaves per seedling (11.80, 14.00 and 16.78) and minimum days required for first sprouting (14.08) which was significantly superior among all the containers used. The present study was carried out to observe the seed germination and seedling growth parameters of papaya in different media and containers in Raipur agroclimatic condition.

Keywords: Papaya, seedlings, Red lady, growing media, containers.

INTRODUCTION

Papaya (*Carica papaya* L.) is a crucial tropical fruit crop, referred to as wonder fruits of tropics. It belongs to the Caricaceae family, originated in Tropical America (Hafner, 1990) and introduced in India during 16th century from Malacca. Biologically diverse forms of cultivated papaya, which may be monoecious, dioecious and gynodioecious (Ray, 2002). With ageing, the productivity of papaya seed deteriorated rapidly. The seed is covered in a gelatinous sarcotesta (outer seed coat), produced from the outer integument to avoid germination. Seed viability declines because the gelatinous sarcotesta persists unchanged with a more prominent impact in dried seeds than in fresh ones. Dormancy is additionally observed in seeds from which the aril has been removed (Yahiro, 1979). Papaya is

usually propagated by seed (Cheema and Dhani, 1990). Many factors affect seedling vigour like seed quality, type of substrate used, seed treatments, climatic factors and many more. The germination of seed of papaya (*Carica papaya*) is usually reported to be slow, erratic and is incomplete (Chako and Singh, 1971).

Growing media are one of the important aspects of horticultural production systems in the world. Soil, vermicompost, poultry manure, FYM, cocopeat and sand are some of the growing media used in this experiment. A good growing medium provides adequate support to the plant. It is the reservoir for nutrients and water, allow oxygen to diffuse in the roots and permit gaseous exchange between the roots and atmosphere outside the root substrate (Abad *et al.*, 2002). The standard of seedlings under nursery, is extremely influenced by growing media (Agbo and

Omaliko, 2006). The soil is a primary medium as it is cheap and elementary to obtain supplementing of the soil which is used to form media more porous while the organic matter such as- Vermicompost, FYM, Cocopeat, etc. is added so as to enhance sufficient nutrients for the growth of seedlings. Cocopeat is an agricultural by-product obtained after the extraction of fiber from the coconut husk (Abad *et al.*, 2002). Cocopeat is taken into account as a good growing media component with acceptable pH, electrical conductivity and other chemical attributes (Abad *et al.*, 2002). The cocopeat can hold adequate amount of water, a bit like a sponge. Vermicompost holds nutrients for a good time while the traditional compost is unable to carry the specified amount of macro and micro nutrients including the vital NPK to plants in less time (Sinha *et al.*, 2009). Sand, a basic component of soil, ranges in particle size from 0.05mm to 2.0mm in diameter. Fine sands (0.05mm – 0.25mm) do little to enhance the physical properties of a growing media and should end in reduced drainage and aeration. Poultry manure is used as an organic fertilizer, especially for soil low in nitrogen. Of all animal manures, it has the highest amount of nitrogen, phosphorus, and potassium.

Red lady is excellent variety of papaya because of hermaphrodite nature and prolonged shelf life. But the seed cost is extremely high (Rs. 2.0 lakh kg⁻¹) so, increasing germination percent and producing more healthy seedling may be a challenge for papaya growers.

Polythene bags are available in several volumes and therefore the other containers also are available in various shape and size. In the recent times, many tropical tree seedlings were grown in different polybags. But no information is known on what size and what sort of container can be employed to gain optimum growth of seedlings in limited time. Therefore, this study was carried out to see the seed germination and seedling growth parameters of papaya in several media and containers in Raipur agroclimatic condition.

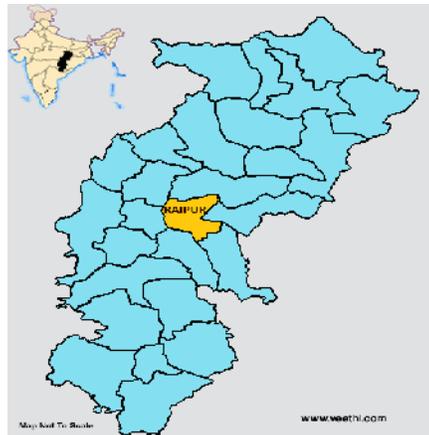


Preparation of different growing Media.

MATERIALS AND METHODS

Climate and weather conditions: The present experiment was administered in Hi-tech nursery located at Centre of Excellence on Protected Cultivation and

Precision Farming, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, during the year 2019- 2020. Geographically, Raipur is located in South-Eastern part of Chhattisgarh. It is intersected by 21°16'N latitude and 81°36'E longitude and an altitude of 298.56 meter above the ocean level. Summers are quite hot with temperature ranging from 45°C to 24.1°C and maximum temperature is recorded in May (45.5°C). Winter months are December-January.



Experimental material: Growing media viz., sand, soil, poultry manure, FYM, cocopeat and vermicompost were used in same ratio as a mixture for sowing seeds. Green bags (6 × 6 inches), black polybags (4 × 6 inches), white polybags (4 × 6 inches) were filled with mixture of above said growing media as per the treatments. The experiment was carried out in a Factorial Complete Randomized Design with combination of 15 treatments, 1 control and 3 replications. The data were recorded during the period of study and subjected to statistical analysis of variance. The polybags were irrigated just after sowing and this was carried out each day with light irrigation until seedling emergence. After the germination was completed in every polybag, light irrigation was followed at every alternate days.



Papaya seedling sprout.

Table 1: Treatment Details.

Growing media (M): 5 (Five) levels	M ₀	Soil + FYM
	M ₁	Soil + FYM + cocopeat (1:1:1)
	M ₂	Soil + FYM + vermicompost (1:1:1)
	M ₃	Soil + FYM+ sand (1:1:1)
	M ₄	Soil +FYM+ poultry manure (1:1:1)
	M ₅	Soil + FYM + sand+ vermicompost (1:1:1:1)
Containers (C):3 (Three) levels	C ₁	Green bag
	C ₂	Black polybag
	C ₃	White polybag



Papaya seedling at 30 DAS.



General view of papaya seedlings at 60 DAS.

Treatment evaluations/measurements: Data was recorded on all seedling growth parameters at 30 days, 45 days and 60 days after sowing, in randomly-selected seedlings of each treatment.

Survival percentage: Survival percentage of papaya seedling was observed after transplanting them in the field. Plants of each treatment were transplanted in field and survivability up to 15 days after transplanting was calculated using the formula:

$$\text{Survival percentage} = \frac{\text{Total no. of surviving seedling}}{\text{Total no. of transplanted seedling}}$$

RESULTS AND DISCUSSIONS

The study of data given in table indicates that the media M_5 i.e. Soil + FYM + Sand + Vermicompost (1:1:1:1) was found best followed by media M_2 (Soil + FYM + Vermicompost) and M_1 ((Soil + FYM + Cocopeat) with respect to germination, growth and survival as these media have good physical properties, good water holding capacity and acids. Among the containers, C_3 i.e. White polybag was found to be the most suitable followed by C_1 (Green bag). Treatment combination M_5C_3 i.e. Soil + FYM + Sand + Vermicompost (1:1:1:1) + C_3 (White polybag) was found to be most suitable for raising the papaya seedlings

Effect of Media: The media M_2 i.e. Soil + FYM + Vermicompost (1:1:1) took minimum days (14.50) to first germination among other growing media, while, M_4 (Soil + FYM + Poultry manure) took maximum days (15.61) to first germination which was non-significantly influenced by different growing media. M_0 i.e. Soil + FYM significantly recorded the minimum days required for 50 per cent germination (13.75) while M_4 significantly took maximum days (15.11) for 50 per

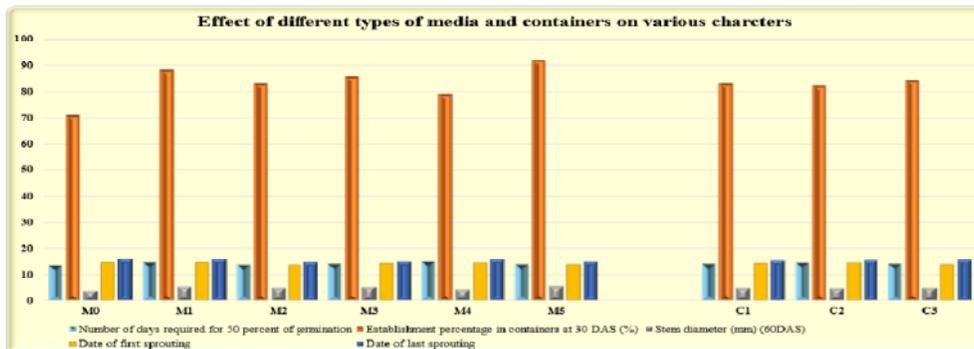
cent germination. M_5 significantly recorded the maximum germination (92.02%) at 30 DAS, of papaya seed among all the growing media, the reason for it could be that the media contains organic manures which possess organic acid within them. Hence, more available moisture and some organic acids may have aided in better germination percentage (Bisla *et al.*, 1984). Similar results were also obtained by Devaranavadgi *et al.*, (2010) in various tree species, Hasan *et al.*, (2010), Bhardwaj (2013) and Bhardwaj (2014) in papaya, while the minimum (71.18) was observed in media M_0 -Soil + FYM. M_5 significantly recorded the highest height of seedling i.e. 11.28, 13.33 cm and 14.44 cm as compared significantly recorded minimum days required to first sprouting (13.89) of papaya seeds. It may be because of Vermicompost which contain plant growth regulating acids like humic acid (Muscolo, 1999) and plant growth regulators viz., auxin, gibberellins and cytokinins Tomati *et al.*, (1988), also responsible for increase in plant growth of many crops (Atiyeh *et al.*, 2002), while the media M_1 Soil + FYM + cocopeat (1:1:1) took significantly maximum days (14.89) for first sprouting. The media M_5 Soil + FYM + Sand + Vermicompost (1:1:1:1) significantly recorded minimum days required to last sprouting (15.00) while M_0 took significantly maximum days (16.08) for last sprouting. M_2 i.e. Soil + FYM + Vermicompost (1:1:1) recorded the significantly maximum establishment (87.21%) as compared to rest of the growing media while minimum establishment (78.89%) was noted in M_3 i.e. Soil + FYM + Sand (1:1:1) as compared to rest of the media. Vermicompost shows hormone-like activity and helps in increasing the number of roots, therefore, boosting nutrient uptake of plant as well as plant growth and development (Alvarez and Grigera, 2005). The above results were also in agreement with Anand *et al.*, (2017) ; Chiranjeevi *et al.*, (2018)

Effect of Container: Out of the various containers, C_3 (White Polybag) took non-significantly minimum days (14.89) for initiation of germination and was found at par with container C_1 (green bag), while, C_2 (Black polybag) took maximum days (15.14) for initiation of germination. Similar results were found in aonla (Saroj *et al.*, 2000). Significantly, the minimum days required for 50 per cent germination (14.13) was observed in C_3 (White polybag) while the maximum days required for 50 per cent germination (14.63) of papaya seeds was observed in C_2 (Black polybag). The maximum establishment percentage (84.36%) of papaya seeds and maximum number of leaves per seedling viz, 11.80, 14.00 and 16.78 were recorded at 30, 45 and 60 DAS in C_3 (White polybag) was recorded in C_3 (White Bag) and remained at par with C_1 (Green bag). The maximum height of seedling i.e. 9.26, 10.96 and 12.12 cm, were recorded at 30, 45 and 60 DAS, respectively in container C_3 (White polybag). Same type of results were observed by Araujo *et al.*, (2006) in papaya seedlings and Farhana *et al.*, (2010) in *Albizia procera* seedlings maximum stem diameter (3.96 mm)

(4.85 mm) at 45DAS, 60 DAS was recorded in C₃ (White Polybag) followed by C₁ (Green bag). However, minimum stem diameter (4.67 mm) was recorded in C₂ (Black polybag) at 60 DAS. Significantly the minimum days required for first sprouting (14.08) of papaya seeds was observed in C₃ (White polybag) among the rest of the containers. The minimum days required for last sprouting (15.46) of papaya seeds was observed in

C₁ (Green Bag) as compared to other containers. While, the maximum days required for last sprouting (15.74) of papaya seeds was observed in C₃ (White polybag). Non-significantly, the maximum survival percentage (84.25%) was recorded by C₁ (Green bag) as compared to remainder of container. The above results were also in agreement of Ritesh *et al.*, (2015) and Bali *et al.*, (2013).

Graph 1: Effect of different types of media and containers on various characters.



Interaction Effect: Significantly the minimum days required for 50 per cent germination (13.330) of papaya seeds was noted in M₃C₁ (Soil + FYM+ sand (1:1:1) +Green bag) among all the media and container interaction, while M₃C₂ (Soil + FYM+ sand (1:1:1) + Black polybag) took maximum (15.667) days required for 50 per cent germination of papaya seeds among the different media and container. Significantly the minimum days required for first sprouting (13.660) of papaya seeds was noted in M₅C₃ (Soil + FYM + sand+ vermicompost (1:1:1:1) +White polybag) among all the combination, While, M₃C₂ (Soil + FYM + Sand (1:1:1) + Black Polybag) took significantly maximum days (15.667) for first sprouting among rest of the combination.

Significantly the minimum days required for last sprouting (14.33) of papaya seeds was noted in combination M₂C₁ Soil + FYM + vermicompost (1:1:1) + Green bag, while the maximum days required for last sprouting (16.667) of papaya seeds was observed in M₄C₁ i.e. Soil + FYM + Poultry manure (1:1:1) + Green Bag as compared to the rest of the combinations. Significantly the combination (M₂C₁ Soil + FYM + vermicompost (1:1:1) + Green bag) recorded the maximum survival percentage (91.667) among all the combinations. While, the minimum establishment percentage (76.00) was found in M₄C₃ (Soil + FYM + poultry manure (1:1:1) + White polybag) in rest of the combinations. The above results were in agreement with Vaghamsi and Delvadia (2006) ; Kumar and Arora (2007).

Table 2: Effect of different growing media and containers on number of days required for initiation of germination, Number of days required for 50 percent of germination, Establishment percentage in containers at 30 DAS (%), Plant height (30, 45, 60 DAS).

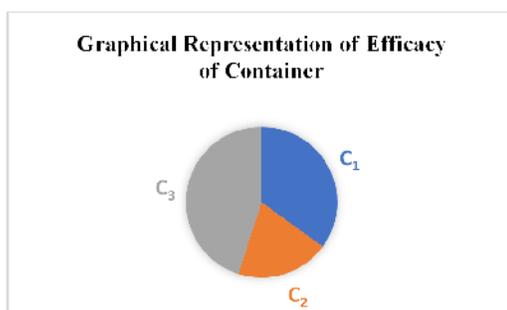
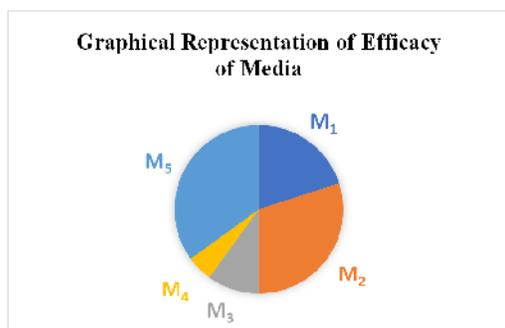
	Number of days required for initiation of germination	Number of days required for 50 percent of germination	Establishment percentage in containers at 30 DAS (%)	Plant height (30 DAS)	Plant height (45 DAS)	Plant height (60 DAS)
M ₀	14.81	13.75	71.17	6.58	7.62	8.37
M ₁	15.44	14.89	88.38	10.28	12.17	13.11
M ₂	14.50	13.89	83.25	8.72	10.22	11.78
M ₃	14.72	14.22	85.87	9.39	11.39	12.67
M ₄	15.61	15.11	79.15	7.17	8.44	9.44
M ₅	14.78	14.11	92.02	11.28	13.33	14.44
SEm±	0.33	0.13	0.42	0.24	0.24	0.18
CD@5%	0.94	0.38	1.19	0.70	0.68	0.51
C ₁	14.91	14.24	83.19	8.93	10.49	11.59
C ₂	15.14	14.63	82.37	8.51	10.13	11.20
C ₃	14.89	14.13	84.36	9.26	10.96	12.12
SEm±	0.23	0.09	0.29	0.17	0.17	0.13
CD@5%	0.67	0.27	0.84	0.49	0.48	0.36
C.V. %	6.59	2.80	1.50	8.19	6.78	4.62
Interaction (M×C) SEm±	0.57	0.23	0.72	0.42	0.41	0.31
Interaction (M×C) CD@5%	1.63	0.67	2.06	1.21	1.18	0.89

Table 3: Effect of different growing media and containers on stem diameter (45, 60 DAS), Number of leaves (30, 45, 60 DAS), Date of first sprouting, Date of last sprouting, Survival percentage after planting in field.

	Stem diameter (mm) (45DAS)	Stem diameter (mm) (60DAS)	Number of leaves (30 DAS)	Number of leaves (45 DAS)	Number of leaves (60 DAS)	Date of first sprouting	Date of last sprouting	Survival percentage after planting in field
M ₀	3.07	3.75	9.12	10.82	12.87	14.80	16.08	83.53
M ₁	4.30	5.27	12.89	15.00	18.22	14.89	16.00	86.32
M ₂	3.90	4.77	10.94	12.94	15.39	13.89	15.00	87.21
M ₃	4.14	5.07	11.67	13.94	16.78	14.44	15.22	84.22
M ₄	3.45	4.21	9.89	11.56	13.83	14.67	16.00	82.85
M ₅	4.48	5.47	14.33	17.00	20.17	14.00	15.22	78.89
SEm±	0.02	0.02	0.23	0.26	0.48	0.12	0.12	0.55
CD@5%	0.06	0.07	0.66	0.76	1.36	0.34	0.35	1.59
C ₁	3.89	4.75	11.46	13.47	16.09	14.52	15.46	84.25
C ₂	3.82	4.67	11.16	13.16	15.76	14.74	15.57	83.34
C ₃	3.96	4.85	11.80	14.00	16.78	14.08	15.74	83.92
SEm±	0.01	0.02	0.16	0.19	0.34	0.08	0.09	0.39
CD@5%	0.04	0.05	0.47	0.53	0.96	0.24	0.25	1.12
C.V. %	1.57	1.51	6.06	5.84	8.81	2.47	2.34	1.98
Interaction (M×C) SEm±	0.04	0.04	0.40	0.46	0.82	0.21	0.21	0.96
Interaction (M×C) CD@5%	0.10	0.12	1.15	1.31	2.36	0.59	0.60	2.75

CONCLUSION

It can be concluded that out of all the growing media, M₅ i.e. Soil + FYM + Sand + Vermicompost (1:1:1:1) was observed to be the most effective for better germination of papaya seeds and also for growth, vigour and establishment of papaya seedlings in containers and in main field and was at par with M₂ (Soil + FYM + Vermicompost) and M₁ (Soil + FYM + Cocopeat). Similarly, among the containers used, C₃ (white Polybag) showed early germination, and was better on the growth parameters and was at par with C₃ (Green bag). Therefore, the combination of M₅C₃ i.e. Soil + FYM + Sand + Vermicompost (1:1:1:1) + (White polybag) found to be most suitable for raising the papaya seedlings as it gave better growth and survival of seedlings.



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Conflict of Interest. Nil.

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