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

ABSTRACT

An experiment was conducted to Effect of Different Growing Media on Seed Germination, Seedling Growth and Establishment of Papaya (*Carica papaya* L.) cv. Red Lady during 2023-24. Three different types of media were used for study. Present experiment was conducted in a Randomized Block Design with 9 treatment combinations replicated thrice. The observations were recorded on seed germination attributes and seedling growth parameters. The results showed that the plastic containers were found better followed by earthen pots and polybags using media mixture of soil + vermicompost + cocopeat (1:2:1) for Days of germination (14.73) and improving seed germination (91.93%). However, the maximum seedling height (13.20 cm), number of leaves (13.40), chlorophyll content (67.85), shoot length (9.62cm), grith of seedling (5.74mm), Seedling Vigor index (1213.75), fresh weight of seedling (18.98 g), leaf area (46.05 cm^2) and seedling survival percentage (83.27%) was observed with highest net profit (Rs.323227.5/1000 seedling) and B:c ratio (3.47) of seedling. The seed germination and plant growth parameters and seedling survival were recorded in polybags.

Key word: Seedling, Polybag, Container, Red lady, Papaya.

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 (Hafmer, 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).

Initial mortality and incomplete germination are one of the causes of reduced survival percentage of papaya plants. High quality papaya seedlings for the formation of plants with high genetic potential can ensure the success of fruit production (Albano *et al*. 2014). Seedling quality is associated with factors such as adequate formation; robust and welldistributed root system and low relationship between shoot and root phytomass (Costa *et al*. 2015, Sanches *et al*. 2017). Use of suitable growing media is essential for production of healthy plants as it is directly affecting the development and later maintenance of the

extensive functional rooting system. Media composition used influences the quality of seedling (Wilson *et al*. 2001).

The topography and climate prevailing in these states are ideal for the quality production of papaya. Caricaxanthin imparts the yellow to orange colour of papaya fruits. It is a very refreshing and delicious fruit and is highly valued for its digestive properties. Meena *et al*. (2017) also advocated that juice of papaya also acts as an in vitro antiproliferative against liver cancer cells due to presence of the caricaxanthin and lycopene. Regular consumption of papaya can reduce the risk of heart disease, diabetes, cancer. Ripe papayas are used for the extraction of papain which has high medicinal value and is also used as industrial ingredients for the preparation of tanning, cosmetic, optical, and brewery (Dayeswari *et al*., 2017).

MATERIAL AND METHOD

Study site

The field study was conducted in Prayagraj district which comes under subtropical belt with semi-arid climatic condition with both extremes of temperature i.e., winter and summer. The maximum temperature of the location reaches up to 46˚-48˚C and seldom falls as 4˚-5˚C. The relative humidity ranges between 20% to 94%. The average rainfall in this area is around 900-1100 mm annually. The minimum temperature during the crop season was to be 5.9˚C and the maximum is to be 29.04˚C. The maximum humidity was to be 42.72% and maximum was to be 93.28%.

Layout and treatment combination

Studies on seed and seedling growth were carried out on papaya variety Red lady during 2023-2024 at Horticulture Research Farm of Naini Agricultural Institute, SHUATS, Prayagraj, (Uttar Pradesh). The experiment was laid out in RBD viz. Media at nine levels viz. T0: control, T_1: Soil + FYM(1:1), T_2: Soil + Cocopeat (1:1), T_3: Soil + Vermicompost (1:1), T_4: Soil + FYM + Cocopeat (1:1:1), T_5: Soil + FYM + Vermicompost (1:1:1), T_6: Soil + FYM + Cocopeat (1:2:1), T_7: Soil + Vermicompost + Cocopeat (1:2:1) and T_8: 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.

Methods for different parameters

Observation on germination parameters was recorded from the first germination until no further germination at two days interval. The imbibition period, number of days from sowing to commencement of germination was recorded for all treatments. Germination

percentage was calculated by number of germinated seedlings divided by total number of seed sown in containers multiplied by 100. The germination period was calculated as the difference between initial and final emergence (number of days) recorded. Seed vigour was calculated as:

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

Data on growth parameters were recorded at the time of transplanting (45 days after sowing). Seedling height was measured with a metric scale and consisted of distance from plant collar to its apex, while stem girth was measured using Vernier caliper. Counting of number of leaves was done after emergence of true leaves. Leaf area was calculated by leaf area meter model no EMP-171492. Root length was measured by uprooting the plant. Seed vigour index was calculated as (Gupta 1993):

$$Seed\ viguor\ index = Germination\ percent * seedling\ length$$

Germination percentage was calculated by number of germinated seeds divided by the total number of seeds sown in polybags, and multiplied by 100. Germination period was calculated as the difference between initial and final emergence (number of days). Seed vigour was calculated by dividing total number of healthy seedlings by total number of seedlings, and multiplied by 100. Germination index was calculated as described in the Association of Official Seed Analysis (1983) using the following formula:

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

Survival percent was recorded as:

$$\text{Survival percent } = \frac{Total\ \text{Survival transplant plants}}{Total\ \text{transplant plants}} * 100$$

All data was subjected to analysis of variance (ANOVA) to determine significant difference and comparison of mean at a significant level of 5%.

RESULTS AND DISCUSSION

1. Germination parameters

1.1 Days to germination

The Days to germination among the different treatments differed significantly. The treatment T_7Soil + Vermicompost + Cocopeat (1:2:1) recorded maximumDays to germination (14.73). Whereas the minimum Days to germination (20.53) was recorded in the treatment T_0 Control.

1.2 Germination percentage

The Germination percentageamong the different treatments differed significantly. The treatment T_0 Control recorded minimum Germination percentage(70.93). Whereas the maximum Germination percentage(91.93) was recorded in the treatment T_7Soil + Vermicompost + Cocopeat (1:2:1).

2. Growth parameters

2.1 No. of leaves

The No. of leaves among the different treatments differed significantly. The treatment T_0 control minimum No. of leaves (8.00). Whereas the maximum No. of leaves(13.40) was recorded in the treatment T_7Soil + Vermicompost + Cocopeat (1:2:1).

2.2 Shoot length (cm)

The Shoot length (cm)among the different treatments differed significantly. The treatment T_7 Soil + Vermicompost + Cocopeat (1:2:1) maximumShoot length (cm) (9.62). Whereas the minimum Shoot length (cm) (7.85) was recorded in the treatment T_0 Control.

2.3 Seedling height (cm)

The Seedling height (cm) among the different treatments differed significantly. The treatment T_7 Soil + Vermicompost + Cocopeat (1:2:1) recorded maximumSeedling height (cm) (13.20). Whereas the minimum Seedling height (cm) (11.43) was recorded in the treatment T_0 Control.

2.4 Grith of seedling (mm)

The Grith of seedling (mm) among the different treatments differed significantly. The treatment T_0 control recorded minimum Grith of seedling (mm) (3.44). Whereas the maximum Grith of seedling (mm) (5.75) was recorded in the treatment T_7 Soil + Vermicompost + Cocopeat (1:2:1).

2.5 Seedling vigour index

The Seedling vigour index among the different treatments differed significantly. The treatment T_0 control recorded minimum Seedling vigour index (811.00). Whereas the maximum Seedling vigour index(1213.75) was recorded in the treatment T_7 Soil + Vermicompost + Cocopeat (1:2:1).

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2.6 Fresh weight of seedling (g)

The Fresh weight of seedling (g) among the different treatments differed significantly. The treatment T_7 Soil + Vermicompost + Cocopeat (1:2:1) recorded maximumFresh weight of seedling (g) (18.98). Whereas theminimum Fresh weight of seedling (g) (12.05) was recorded in the treatment T_0 Control.

2.7 Leaf area

The Leaf area among the different treatments differed significantly. The treatment T_0 control recorded minimum Leaf area (32.53). Whereas the maximum Leaf area (46.05) was recorded in the treatment T_7 Soil + Vermicompost + Cocopeat (1:2:1).

3. Survival and establishment

3.1 Survival percentage

The Survival percentage among the different treatments differed significantly. The treatment T_7 Soil + Vermicompost + Cocopeat (1:2:1) recorded maximumSurvival percentage (83.27).Whereas the minimum Survival percentage (47.27) was recorded in the treatment T_0 Control.

4. Economics

Application of Soil + vermicompost + Cocopeat (1:2:1) with 2 cm cocopeat media (T7) for 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, respectively due to higher germination percent and survival percent obtained (Tables 1 and

3). This treatment was significantly superior to the rest of the treatments during year but cost benefit ratio was at par with T. treatment.

CONCLUSION

In conclusion, presented results showed that FYM, vermicompost and cocopeat, due to suitable physical, chemical and biological properties could be used successfully in preparation of papaya seedling. On the basis of results obtained from this study, it is concluded that growing media significantly influenced the germination, growth and development parameters of papaya seedling in which medium of Soil + vermicompost + Cocopeat (1:2:1) with 2 cm cocopeat filling of poly bags was the best media since the germination, seedling growth and development parameters were higher than those on the other media. Therefore, this result suggested that Soil, vermicompost and Cocopeat with cocopeat should be used as growing media for higher germination percent quickening of papaya seedling growth and earn more profit by sale of seedlings.

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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 1. Germination 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 2. Shoot 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

Table 3. Seedling efficacy against different treatment combinations