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Research Article

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Effect of Potting Media on Seed Germination, Seedling Growth and Vigour in TNAU Papaya Co.8 (*Carica papaya* L.)

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ABSTRACT

Papaya is one of the most important fruit crops belongs to the family Caricaceae grown in tropical to subtropical areas all over the world and is mainly propagated by seeds which show wide variability in germination and seedling growth. The present experiment was conducted to study the influence of potting media on seed germination, seedling growth and vigour in TNAU Papaya CO.8 with different treatments viz., control (M_1), cocopeat + vermicompost + azospirillum + phosphobacteria (M_2), cocopeat + vermicompost + pseudomonasfluorescens (M_3), cocopeat + azospirillum + phosphobacteria (M_4), cocopeat + azospirillum + phosphobacteria + pseudomonasfluorescens (M_5) and cocopeat + vermicompost + azospirillum + phosphobacteria + pseudomonasfluorescens (M_6) were evaluated and compared. the best results were obtained by cocopeat + vermicompost + azospirillum + phosphobacteria + pseudomonasfluorescens (M_6) followed by cocopeat + vermicompost + pseudomonasfluorescens (M_3) which showed highest seed germination percentage, seedling height, seedling girth, leaf nutrient contents, chlorophyll content and leaf soluble protein content.

Key words: *Cocopeat, vermicompost, Azospirillum, Phosphobacteria, Pseudomonasfluorescens, papaya, seed germination, seedling growth and vigour.*

INTRODUCTION

Papaya (*Carica papaya* L.) belongs to the family Caricaceae. It is known to be originated from Tropical America. It is dicotyledonous, polygamous diploid species with a small genome[5] of 372 Mbp/1C[5] having nine pairs of chromosomes[8] and was introduced to India in the 16th century. India is the largest producer of papaya covering an area[3] of 1.15 lakh ha, producing 49.12 lakh tonnes/ ha [3]. It is extensively grown in the states of Tamil Nadu, Andhra Pradesh, Assam, Bihar, Maharashtra, Uttar Pradesh, Gujarat, Punjab, West Bengal, Madhya Pradesh, Karnataka etc. It is largely consumed locally although it has huge potential for export.

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It has long been grown primarily for its delicious fruits which are the rich source of carbohydrate, minerals, vitamin A, and ascorbic acid. The fruits can be used in the preparation of products like jam, jelly, tuty-fruity, marmalade, nectar, wines, syrup, dehydrated flakes and baby foods. The digestive enzyme papain, obtained from latex is an industrial ingredient used in pharmaceuticals, brewery, meat, dairy, textile, photographic, optical, tanning, cosmetic, detergent, food and leather industries and so there is a growing demand for the papain. Papaya is a short duration fruit crop, owing to its high productivity and high returns, it is becoming very popular with many growers[10].

Seedling vigour is affected by many factors like seed quality and seed treatments, type of substrate used, environmental factors etc. Some of the problems faced by papaya growers are slow, erratic and incomplete germination of papaya and high initial seedling mortality. Thus increasing the germination percentage and producing healthier seedling of papaya. It is mainly propagated through seeds. The quality of seedlings obtained from a nursery influences re-establishment in the field and the eventual productivity of an orchard. Plant vigour depends on the seedling vigour. Hence attention has to be given from nursery stage itself in order to improve the seedling vigour.

Growing media also plays an important role in seed germination, seedling growth and vigour. The current practice for raising nursery is use of polythene bags with the potting media consisting of FYM: Soil: Sand mixed in 1:2:1 ratio. To avoid damage to the root system and retain the media intact with the rooting zone, seedlings are transplanted along with the entire polythene bag which is not biodegradable. This is a constraint hindering proper development and penetration of the roots.

Thus, a effective potting media for papaya should be physically very stable, should not interfere with plant nutrition, light in weight for easy transport and can minimize the soil borne diseases. A good media should have the qualities to be intact with the root system when the seedlings are uplifted for transplanting.

MATERIALS AND METHODS

The experiment was conducted at the nursery, University Orchard, Department of Fruit Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore during 2015-2016. The experiment was laid out in completely randomized design with three replications in polythene bags. For each replication 25 polythene bags were raised for this study. Six seeds were sown at 0.5-1.0 cm depth in black polythene bags of 15 x 10 cm size and polybag thickness in 150 gauge.

The experiment comprised of six different potting media were used based on the earlier studies conducted in papaya and other crops. *viz*., control (M_1), cocopeat + vermicompost + *azospirillum* + phosphobacteria (M_2), cocopeat + vermicompost + *pseudomonasfluorescens* (M_3), cocopeat + *azospirillum* + phosphobacteria (M_4), cocopeat + *azospirillum* + phosphobacteria + *pseudomonasfluorescens* (M_5) and cocopeat + vermicompost + *azospirillum* + phosphobacteria + *pseudomonasfluorescens* (M_6) The seeds of Co.8 papaya were sown in the pre-filled polybags.

Rate of emergence

Three replicates of four fifty seeds from each treatment were used to test the speed of germination of seeds from different treatments. The seeds showing radicle protrusion more than 3.0 mm was counted daily from tenth day after sowing until thirty days. From the number of seeds germinated on each day, the speed of germination was calculated using the following formula and the result was expressed in whole number[16].

Rate of emergence = $(X_1/Y_1) + (X_2-X_1/Y_2) + \ldots X_n - (X_n-1)/Y_n$

X_1- number of seeds germinated at first count

X_2- number of seeds germinated at second count

X_n- number of seeds germinated on n^{th} day

Y_1- number of days from sowing to first count

Y_2- number of days from sowing to second count

Y_n- number of days from sowing to n^{th} count

Vigour index

Vigour index was calculated by adopting the method suggested by Abdul-Baki and Anderson (1973) and expressed in whole number[1].

Vigour index = Germination (%) x Total seedling length (cm)

RESULTS AND DISCUSSION

A good growing medium for the nursery is of vital importance as it promotes water absorption, nutrient availability and oxygen supply to the germinating seeds and seedlings. Growing media not only acts as a growing place but also as a source of nutrient for plant growth. Media composition used influences the quality of seedlings[19].

In the present study, the data represented in Table 1- 4 showed that significant effect on catena of observations *viz*., days taken for germination, germination percentage, rate of emergence, seedling height and girth, number of leaves, leaf area, vigour index, shoot and root biomass were found to be the highest in the combination of cocopeat + vermicompost + *azospirilium* + phosphobacteria + *pseudomonas flourescens* (M_6) followed by M_3 (cocopeat + vermicompost + *pseudomonas flourescens*). This finding is in accordance with the reports of Shanmugavelu[17] and Kumawat *et al.*[15] in papaya and Choudhari and Chakrawar[11] on kagzi lime.

Table 1: Effect of potting media on germination efficacy

Treatments	Days taken for germination	Germination percentage	Rate of emergence
M_1	19	88.00 (69.73)	21.64
M_2	15	96.89 (79.84)	25.49
M_3	**12**	**97.33** (80.52)	**28.16**
M_4	17	92.66 (74.28)	25.72
M_5	16	91.55 (73.10)	23.87
M_6	**13**	**97.78** (81.43)	**29.66**
Mean	**15.20**	**81.58**	**22.54**
SEd	**0.24**	**1.34**	**0.35**
CD (0.05)	**0.54**	**2.99**	**0.78**
CV%	**1.94**	**1.72**	**1.65**
Significance	*	**	**

The significant increase in seed germination and seedling growth characters in M_6 might be due to the improvement in soil texture, porosity, water holding capacity, activity of soil microflora and fauna which helps in maintaining soil temperature and improving soil health nutrients of the medium as reported by Hartmann and Kester[13]. The increase in germination might also be due to the fact that coir dust (cocopeat) when mixed with organic manure improves the overall physical traits of the media[12] which was confirmed in ornamentals[18].

Table 2: Effect of potting media on seedling growth parameters

Treatments	Seedling height (cm)			Seedling girth (mm)			Number of leaves			Leaf area (cm^2)			Vigour index	Days taken to attain 15 cm height
	37 DAS	44 DAS	51 DAS	37 DAS	44 DAS	51 DAS	37 DAS	44 DAS	51 DAS	37 DAS	44 DAS	51 DAS		
M_1	12.10	13.30	16.07	1.54	1.66	1.68	6.00	6.20	6.75	9.36	9.89	10.0	3182	42
M_2	17.00	25.20	30.30	2.67	2.95	3.23	6.00	6.20	6.50	13.2	15.2	15.5	4974	33
M_3	**21.90**	**29.00**	**33.50**	**2.98**	**3.12**	**4.07**	**7.80**	**7.90**	**8.20**	**17.1**	**17.8**	**19.8**	**5012**	**31**
M_4	12.13	13.37	17.50	1.33	1.62	1.69	6.00	6.00	6.20	9.79	9.86	10.92	1452	55
M_5	13.68	14.03	17.80	1.30	1.42	1.55	6.00	6.00	6.00	9.82	9.89	10.95	2047	55
M_6	**20.70**	**26.80**	**32.60**	**2.88**	**3.11**	**3.45**	**7.20**	**7.80**	**8.00**	**15.2**	**15.6**	**16.0**	**5395**	**30**
Mean	**15.58**	**19.61**	**23.12**	**2.13**	**2.30**	**2.58**	**6.96**	**6.63**	**7.01**	**11.74**	**12.37**	**12.86**	**3152**	**35.61**
SEd	**0.13**	**0.14**	**0.19**	**0.03**	**0.06**	**0.04**	**0.12**	**0.07**	**0.12**	**0.16**	**0.26**	**0.17**	**38.36**	**0.61**
CD (0.05)	**0.29**	**0.32**	**0.42**	**0.08**	**0.15**	**0.10**	**0.27**	**0.16**	**0.27**	**0.37**	**0.58**	**0.39**	**85.47**	**1.38**
CV%	**1.15**	**1.00**	**1.12**	**2.06**	**3.56**	**2.13**	**2.45**	**1.50**	**2.33**	**1.98**	**2.88**	**1.89**	**1.27**	**1.82**
Significance	**	**	**	**	**	**	*	*	*	**	**	**	**	**

Vermicompost is reported to have bio active principles which are considered to be beneficial for root growth and results in higher germination, enhanced growth and development[7]. Earlier studies on papaya also indicated the beneficial effect of vermicompost as potting mixture which enabled close contact between seed and media thus maintaining steady moisture supply, facilitating root respiration[9] and encouraging overall growth of the seedling[2,9].

Table 3: Effect of potting media on leaf chlorophyll, soluble protein and leaf nutrient contents

Treatments	Chlorophyll content (mg g^{-1})	Leaf soluble protein (mg g^{-1})	N (%)	P (%)	K (%)
M_1	2.12	41.65	0.83	0.62	1.22
M_2	2.46	48.67	1.44	0.75	1.82
M_3	**2.60**	**69.82**	**1.72**	**0.82**	**2.85**
M_4	2.32	43.09	1.17	0.71	1.86
M_5	2.35	44.96	1.22	0.68	1.92
M_6	**2.98**	**61.91**	**1.84**	**0.94**	**2.97**
Mean	**1.91**	**47.68**	**1.62**	**0.75**	**1.85**
SEd	**0.03**	**1.31**	**0.02**	**0.01**	**0.01**
CD(0.05)	**0.07**	**2.92**	**0.05**	**0.02**	**0.03**
CV%	**2.07**	**3.37**	**1.70**	**1.95**	**0.91**
Significance	*	**	**	*	**

Table 4: Effect of seed treatments on shoot and root growth parameters

Treatments	Shoot length (cm)	Root length (cm)	Fresh weight of the shoot (g)	Fresh weight of the root (g)	Dry weight of the shoot (g)	Dry weight of the root (g)
M_1	16.52	11.08	1.08	0.32	0.37	0.07
M_2	30.00	19.00	3.61	0.48	0.77	0.16
M_3	**32.50**	**21.34**	**4.58**	**0.64**	**0.89**	**0.23**
M_4	17.50	12.00	1.74	0.45	0.44	0.09
M_5	17.80	13.20	1.83	0.42	0.52	0.10
M_6	**33.02**	**20.60**	**5.37**	**0.78**	**1.17**	**0.29**
Mean	**23.25**	**14.83**	**2.43**	**0.31**	**0.50**	**0.11**
SEd	**0.46**	**0.32**	**0.04**	**0.009**	**0.01**	**0.002**
CD (0.05)	**1.04**	**0.73**	**0.09**	**0.02**	**0.02**	**0.005**
CV%	**2.52**	**3.03**	**2.07**	**3.75**	**2.65**	**2.36**
Significance	*	**	**	**	**	*

Many reports have indicated the importance of *Azospirillum* in perennial horticultural crops like banana[14] and papaya[12]. The presence of *Azospirillum* in the media helps in fixation of nitrogen and makes it available to the plant. This stimulated supply of nitrogen which would have played a key role in increasing synthesis of chlorophyll and amino acids subsequently into proteins and nucleic acids forming a framework for chloroplast there by better photosynthetic activity[6] as suggested by Awasthi *et al.*[6] while studying the interaction effect of VAM, Mycorrhizae and *Azotobacter* inoculation on peach seedlings. It is also evidenced in the present study that M_6 and M_3 recorded higher leaf NPK contents (1.84, 0.94, 2.97 % and 1.72, 0.82, 2.85 %), leaf chlorophyll content (2.98 mg g^{-1} and 2.60 mg g^{-1}) and leaf soluble protein (61.91 mg $g^{-1}$and 69.82 mg g^{-1}) respectively in leaves. Further, the plant growth promoting activity of the Phosphobacteria and its capacity to solubilise insoluble inorganic phosphates thereby promoting root growth is also well established[4].

Plate 1 : Effect of potting media on seed germination and seedling growth

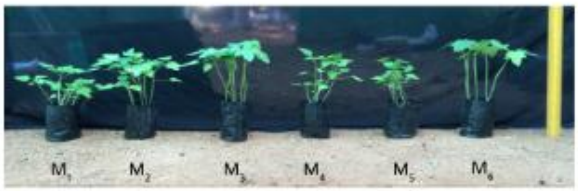
10 DAS

20 DAS

30 DAS

Plate 2. Effect of potting media on seed germination and seedling growth

37 DAS



44 DAS

51 DAS

Plate 3 : Effect of potting media on root biomass

M_1: Control; M_2: Cocopeat + Vermicompost (25g/bag) + Azospirillum (5g/bag) + Phosphobacteria (5g/bag);
M_3: Cocopeat + Vermicompost (25g/bag) + Pseudomonas fluorescens (5g/bag); M_4: Cocopeat + Azospirillum (5g/bag) + Phosphobacteria (5g/bag)
M_5: Cocopeat + Azospirillum (5g/bag) + Phosphobacteria (5g/bag) + Pseudomonas fluorescens (5g/bag)
M_6: Cocopeat + Vermicompost (25g/bag) + Azospirillum (5g/bag) + Phosphobacteria (5g/bag) + Pseudomonas fluorescens (5g/bag)

CONCLUSION

Among the potting media, the minimum days required for germination (12.00 days), maximum germination percentage (97.78 %) and the highest rate of emergence (29.66) was recorded with Cocopeat + Vermicompost + *Azospirillum* + Phosphobacteria + *Pseudomonas fluorescens* (M_6). The seedling growth parameters also recorded the highest for seedling height at 37, 44 and 55 DAS (20.70, 26.80 and 32.60 cm respectively), seedling girth at 37, 44 and 51 DAS (2.88, 3.11 and 3.45 mm respectively), days taken to attain 15 cm height (30 days), shoot length, fresh and dry weight of the shoot (33.02 cm, 5.37g and 1.17g respectively), root length, fresh and dry weight of the root (20.60 cm, 5.37g and 0.29 g respectively). The highest

nitrogen, phosphorous and potassium content (1.84, 0.94 and 2.97 % respectively), chlorophyll content and soluble protein content (2.98 and 61.91mg g^{-1}respectively) were also recorded in M_6 media.

Succeeded by M_3 comprising of Cocopeat + Vermicompost + *Pseudomonas fluorescens* was found to be on par with M_6 for many of seed germination and seedling growth characters. It took 13.00 days for germination with 97.33 % germination and the rate of emergence was 28.16. The seedling growth parameters *viz*., seedling height, girth, shoot length, fresh and dry weight of the shoot, fresh and dry weight of the root were also better in this treatment.

From this study we can conclude that the effect of potting media with cocopeat + vermicompost + *azospirillum* + phosphobacteria + *pseudomonas fluorescens* (M_6) and cocopeat + vermicompost + *pseudomonas fluorescens* (M_3) can be recommended for improving seed germination, seedling growth and vigour of TNAU Papaya Co.8

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