

Effect of growing media and polybags on seed germination, growth and seedling establishment of papaya (*Carica papaya*) cv Pusa Nanha

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ABSTRACT

An experiment was conducted on seed germination and seedling establishment of papaya (*Carica papaya*) cv Pusa Nanha as influenced by growing media and containers during 2014-2015 at Department of Horticulture, Sam Higginbottom Institute of Agriculture Technology and Sciences, Allahabad, Uttar Pradesh. Different treatments took 14 to 19 days for completion of germination. The treatment T₃ [Black polybag + vermicompost (VC):soil:sand 2:2:1] resulted in highest seedling height (25.79 cm), had maximum leaves (14), higher stem diameter (1.2 mm), higher plant spread (23.7 cm), higher number of roots (16.03), maximum root length (9.74 cm) and higher survival percentage (88.00). The overall growth and development parameters were thus found significantly higher with the growth media of VC:soil:sand (2:2:1) in black polybag followed by white polybag.

Keywords: Container; farmyard manure; vermicompost; poultry manure; germination; papaya

INTRODUCTION

Papaya (*Carica papaya*) is a tropical fruit having commercial importance because of its high nutritive and medicinal value. It belongs to the family Caricaceae. It is the second richest in vitamin A after mango. Papaya cultivation had its origin in South Mexico and Costa Rica (Singh and Sexena 2008). India leads the world in papaya production with an annual output of about 3 MT. Other leading producers are Brazil, Mexico, Nigeria, Indonesia, China, Peru, Thailand and Philippines. In India it is mostly cultivated in the states of Andhra Pradesh, Karnataka, Gujarat, Orissa, West Bengal, Assam, Kerala, Madhya Pradesh and Maharashtra.

Papaya fruit is a rich source of vitamin A and C. It has a high nutritive and medicinal value. Papain prepared from dried latex of its immature fruits is used in meat tenderizing, manufacture of chewing gum and cosmetics, for degumming natural silk and to give shrink resistance to wool. It is also used in pharmaceutical industries, textile and garment cleaning paper and

adhesive manufacture, sewage disposal etc. Both ripe and raw fruits of papaya are used in the preparation of various products. Papaya fruits are used for the treatment of piles, dyspepsia of spleen and liver, digestive disorders, diphtheria and skin blemishes (Shivakumar et al 2012).

The micronutrients are very effective in activating enzymes responsible for energy metabolism, starch synthesis and nitrate reduction and these encourage strong root and shoot development and undesirable lodging of plants (de Kreij and Van Leeuwen 2001). The method of supplying nutrients to plants in different colour containers increases plant growth and also improves quality of the papaya seedlings.

Proper seed germination and seedling growth are most important considerations in successful seedling production under nursery technique of papaya cultivation. As the germination rate and seedling growth are affected by pre-sowing seed treatment of papaya growth media, an experiment was therefore carried

out to identify a suitable treatment for getting better seed germination and seedling growth vigour.

MATERIAL and METHODS

The experiment was conducted at the department of Horticulture, Sam Higginbottom Institute of Agriculture Technology and Sciences, Allahabad, Uttar Pradesh during the year 2014-2015. The experiment was laid out in factorial complete randomized block design with three replications. The experiment comprised 12 treatment combinations viz T₁ [Black polybag + farmyard manure (FYM):soil:sand 2:2:1], T₂ (Black polybag + FYM:soil:sand 1:2:1), T₃ [(Black polybag + vermicompost (VC):soil:sand 2:2:1)], T₄ (Black polybag + VC:soil:sand 1:2:1), T₅ [(Black polybag + poultry manure (PM):soil:sand 2:2:1)], T₆ (Black polybag + PM:soil:sand 1:2:1), T₇ (White polybag + FYM:soil:sand 2:2:1), T₈ (White polybag + FYM:soil:sand 1:2:1), T₉ (White polybag + VC:soil:sand 2:2:1), T₁₀ (White polybag + VC:soil:sand 1:2:1), T₁₁ (White polybag + PM:soil:sand 2:2:1), T₁₂ (White polybag + PM:soil:sand 1:2:1).

The seeds of papaya cv Pusa Nanha were collected from the Narendra Dev University of Agriculture and Technology, Kumargang, Faizabad, Uttar Pradesh. The seeds were soaked before sowing in the aqueous solution of distillate for 12 hours in a beaker, dried for 10 minutes on newspaper for one hour under shade and dried seeds were immediately sown in the prefilled white and black polythene bags (12 x 10 cm size). Seeds were slightly covered with thin layer of paddy straw and the bags were watered by water cane. The bags were monitored daily and irrigated regularly. The data were recorded on different aspects such as initiation of germination, completion of germination, height of seedlings (cm), number of leaves per seedling, stem diameter (mm), petiole length (cm), plant spread (cm) and per cent survival of papaya seedlings.

RESULTS and DISCUSSION

Data on the effect of growing media and containers on germination and growth of papaya (*Carica papaya*) cv Pusa Nanha seedlings are given in Table 1.

Days taken to initiation of germination: Minimum days taken to initiation of germination (9) were recorded in the treatment T₃ (Black polybag + VC:soil:sand

2:2:1) which was statistically lower than other treatments. Maximum days to initiation of germination (15) were taken by the treatment T₁₂ (White polybag + PM:soil:sand 1:2:1). The possible reason of early germination in T₃ as compared to T₁₂ could be that black colour of polybag maintained temperature and supported phototropic growth of papaya seed. The results are in conformity with the findings Bhardwaj (2014) in papaya.

Days taken to completion of germination:

Different treatments took 14 to 19 days for completion of germination. The treatments T₂ (Black polybag + FYM:soil:sand 1:2:1), T₃ (Black polybag + VC:soil:sand 2:2:1), T₄ (Black polybag + VC:soil:sand 1:2:1) and T₉ (White polybag + VC:soil:sand 2:2:1) were at par with days taken to completion of germination (14-16 days) whereas rest of the treatments took 17 to 19 days. The results are in conformity with the findings of Anburani and Shakila (2010) and Acharjee et al (2015).

Seedling height: Seedling height varied from 15.49 to 25.79 cm in different treatments. The treatments T₁₂ (White polybag + PM:soil:sand 1:2:1), T₆ (Black polybag + PM:soil:sand 1:2:1) and T₈ (White polybag + FYM:soil:sand 1:2:1) resulted in lower seedling height of 15.49, 16.23 and 16.15 cm respectively than the other treatments being statistically on par with one another. The T₃ (Black polybag + VC:soil:sand 2:2:1) resulted in highest seedling height (25.79 cm). The observations are in agreement with the findings of Barche et al (2010) and Deb et al (2010).

Number of leaves per plant: Number of leaves in different treatments varied from 8 to 14. T₁₂ (White polybag + PM:soil:sand 1:2:1), T₁₁ (White polybag + PM:soil:sand 2:2:1), T₆ (Black polybag + PM:soil:sand 1:2:1) and T₈ (White polybag + FYM:soil:sand 1:2:1) had lowest number of leaves (8, 9, 9 and 9 respectively) which were at par with one another whereas T₃ (Black polybag + VC:soil:sand 2:2:1) had maximum leaves (14). Increase in number of leaves might be due to the combination of organic manure that helped in invigoration of physiological process of plant and stimulatory effect of chemicals to form new leaves at faster rate. The results are in line with those of Kumawat et al (2014) and Madiha et al (2015) in papaya seeds.

Leaf area (cm²): Lower leaf area of 61.58, 62.94, 63.82 and 64.26 cm² was recorded in T₁₂ (White polybag + PM:soil:sand 1:2:1), T₈ (White polybag +

Table 1. Effect of growing media and containers on germination and growth of papaya (*Carica papaya*) cv Pusa Nanha seedlings

Treatment	Germination initiation (days)	Germination completion (days)	Seedling height (cm)	Number of leaves	Leaf area (cm ²)	Stem diameter (mm)	Petiole length (cm)	Plant spread (cm)	Number of roots	Root length (cm)	Survival (%)
T ₁	13	17	22.84	11	78.10	0.9	5.12	19.3	11.13	6.30	85
T ₂	13	16	18.74	10	66.34	0.8	4.97	18.5	9.84	5.01	84
T ₃	9	14	25.79	14	97.14	1.2	5.98	23.7	16.03	9.74	88
T ₄	11	15	22.06	12	83.12	1.0	5.54	20.4	14.87	8.41	87
T ₅	14	17	18.92	10	71.68	0.9	4.75	17.9	7.61	4.86	80
T ₆	13	17	16.15	9	63.82	0.8	4.31	17.0	6.07	3.98	81
T ₇	11	18	20.17	10	78.43	0.8	5.00	18.8	10.75	5.17	85
T ₈	12	17	16.23	9	62.94	0.8	4.89	18.0	8.04	4.93	83
T ₉	11	16	24.01	12	94.89	1.1	5.83	22.1	14.22	8.01	87
T ₁₀	12	17	20.42	11	81.51	0.9	5.21	20.0	12.40	7.12	87
T ₁₁	12	18	17.81	9	64.26	0.9	4.53	17.2	6.85	4.07	80
T ₁₂	15	19	15.49	8	61.58	0.8	4.24	16.5	5.91	3.12	80
SED±	0.076	1.113	0.636	0.707	2.269	0.074	1.054	1.326	0.358	0.206	1.130
CD _{0.05}	1.588	2.29	1.313	1.459	4.684	0.153	NS	2.737	1.671	0.574	2.333

T₁ (Black polybag + FYM:soil:sand 2:2:1), T₂ (Black polybag + FYM:soil:sand 1:2:1), T₃ (Black polybag + VC:soil:sand 2:2:1), T₄ (Black polybag + VC:soil:sand 1:2:1), T₅ (Black polybag + PM:soil:sand 2:2:1), T₆ (Black polybag + PM:soil:sand 1:2:1), T₇ (White polybag + FYM:soil:sand 2:2:1), T₈ (White polybag + FYM:soil:sand 1:2:1), T₉ (White polybag + VC:soil:sand 2:2:1), T₁₀ (White polybag + VC:soil:sand 1:2:1), T₁₁ (White polybag + PM:soil:sand 2:2:1), T₁₂ (White polybag + PM:soil:sand 1:2:1)
FYM= Farmyard manure, VC= Vermicompost, PM=Poultry manure

FYM:soil:sand 1:2:1), T₆ (Black polybag + PM:soil:sand 1:2:1) and T₁₁ (White polybag + PM:soil:sand 2:2:1) respectively which were at par with one another with maximum of 97.14 and 94.89 cm² in case of T₃ (Black polybag + VC:soil:sand 2:2:1) and T₉ (White polybag + VC:soil:sand 2:2:1) the two being at par. The results are supported by the work of Babu et al (2010) in papaya.

Stem diameter (mm): Stem diameter was higher in T₃ (Black polybag + VC:soil:sand 2:2:1) and T₉ (White polybag + VC:soil:sand 2:2:1) with 1.2 and 1.1 mm respectively and the two were at par. However all other treatments had lower stem diameter ranging from 0.8 to 0.9 mm except except T₄ (1.0 mm). Meena and Jain (2012) reported that for plant growth differences in nutrients, pH and cation exchange capacity among substrates may be more important than differences in increased seedling growth of papaya plant.

Petiole length: The petiole length ranged from 4.24 to 5.98 cm among the different treatments but there were no significant differences among them for this trait.

Plant spread: Plant spread varied from 16.5 to 23.7 cm in different treatments. The plant spread of 23.7 and 22.1 cm was recorded in T₃ (Black polybag + VC:soil:sand 2:2:1) and T₉ (White polybag + VC:soil:sand 2:2:1) the two being at par and it was higher in comparison to all other treatments. The results are in accordance with the work of Li et al (2015) in papaya seeds.

Number of roots: Number of roots was lower 5.91, 6.07 and 6.85 in case of T₁₂ (White polybag + PM:soil:sand 1:2:1), T₆ (Black polybag + PM:soil:sand 1:2:1) and T₁₁ (White polybag + PM:soil:sand 2:2:1) respectively the three being at par. The treatments T₃ (Black polybag + VC:soil:sand 2:2:1) and T₄ (Black polybag + VC:soil:sand 1:2:1) resulted in higher number of roots (16.03 and 14.87 respectively). The observations are in agreement with the findings of Lazcano et al (2009) and Deb et al (2010) in papaya.

Root length: It was maximum (9.74 cm) in T₃ (Black polybag + VC:soil:sand 2:2:1) and minimum (3.12 cm) in T₁₂ (White polybag + PM:soil:sand 1:2:1). The observations are in agreement with the findings of Angeline and Ouma (2008) and Bhardwaj (2014) in papaya.

Survival Percentage: Higher survival was recorded in T₃ (Black polybag + VC:soil:sand 2:2:1), T₄ (Black polybag + VC:soil:sand 1:2:1), T₉ (White polybag + VC:soil:sand 2:2:1) and T₁₀ (White polybag + VC:soil:sand 1:2:1) of 88, 87, 87 and 87 per cent respectively than all other treatments whereas it was lower (80, 80, 80, 81%) in T₅ (Black polybag + PM:soil:sand 2:2:1), T₁₁ (White polybag + PM:soil:sand 2:2:1), T₁₂ (White polybag + PM:soil:sand 1:2:1) and T₆ (Black polybag + PM:soil:sand 1:2:1) respectively. The results are in conformity with the findings of Chumpookam et al (2012) and Atilla et al (2015) in papaya.

The observations noted on all the parameters were significantly influenced by different growing media but the best results were found in case of treatment black polybag + VC:soil:sand 2:2:1 for all the traits.

REFERENCES

- Acharjee K, Sangma DK, Mishra DK, Deb P and Sinha B 2015. Effect of some Schiff base ligands and their Zn (II) complexes on germination and seedling growth of papaya (*Carica papaya* L). Indian Journal. Advances in Chemical Science **3(2)**: 141-146.
- Anburani A and Shakila A 2010. Influence of seed treatment on the enhancement of germination and seedling vigour of papaya. Acta Horticulturae **851**: 295-298.
- Angeline O and Ouma G 2008. Effect of washing and media on the germination of papaya seeds. ARPN Journal of Agricultural and Biological Science **3(1)**: 8-11.
- Atilla A, Bülent Y and Furuzan A 2015. Effects of three different concentrations of vermincompost on the growth in the 2 + 0 aged seedlings of Anatolian black pine. International Journal of Agriculture, Forestry and Fisheries **3(2)**: 25-31.
- Babu KD, Patel RK, Singh A, Yadav DS, Singh A, Yadav DS, De LC and Deka BC 2010. Seed germination, seedling growth and vigour of papaya under northeast Indian condition. Acta Horticulturae **851**: 299-306.
- Barche S, Singh Kirad K and Singh DB 2010. Response of seed treatment on germination, growth, survivability and economics of different cultivars of papaya (*Carica papaya* L). Acta Horticulturae **851**: 279-284.
- Bhardwaj RL 2014. Effect of growing media on seed germination and seedling growth of papaya cv Red Lady. African Journal Plant Science **8(4)**: 178-184.
- Chumpookam J, Lin HL and Shiesh CC 2012. Effect of smoke-water on seed germination and seedling growth of papaya (*Carica papaya* cv Tainung # 2). HortScience **47(6)**: 741-744.
- de Kreij C and Van Leeuwen GJL 2001. Growth of pot plants in treated coir dust as compared to peat. Communications in Soil Science and Plant Analysis **32(13-14)**: 2255-2265.
- Deb P, Das A, Ghosh SK and Suresh CP 2010. Improvement of seed germination and seedling growth of papaya (*Carica papaya* L) through different pre-sowing seed treatments. Acta Horticulturae **851**: 313-316.
- Kumawat R, Maji S, Govind and Meena DC 2014. Studies on seed germination and seedling growth of papaya (*Carica papaya* L) cv Coorg Honey Dew as influenced by media and chemicals. Journal of Crop and Weed **10(2)**: 281-286.
- Lazcano C, Arnold J, Tato A, Zaller JG and Dominguez J 2009. Compost and vermicompost as nursery pot components: effects on tomato plant growth and morphology. Spanish Journal of Agricultural Research **7(4)**: 944-951.
- Li W, Liu X, Yang Q, Zhang N, Du Y and Zhu H 2015. Preparation and characterization of inclusion complex of benzyl isothiocyanate extracted from papaya seed with β -cyclodextrin. Food Chemistry **184**: 99-104.
- Madiha, Haruna Y, Khan AA and Darma ZU 2015. Effect of acid rain on growth of papaya (*Carica papaya*) and castor (*Ricinus communis*) plants. e-Journal of Science and Technology **9(1)**: 43-47..
- Meena RR and Jain MC 2012. Effect of seed treatment with gibberellic acid on growth parameters of papaya seedlings (*Carica papaya* L). Progressive Horticulture **44(2)**: 248-250.
- Shivakumar BS, Dharmatti PR and Channal HT 2012. Effect of organic cultivation of papaya on yield, economics and soil nutrient status. Karnataka Journal of Agricultural Sciences **25(4)**: 488-492.
- Singh R and Sexena SK 2008. Fruits. National Book Trust, New Delhi, India, 127p.