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EVALUATION OF ALTERNATE POTTING MEDIA MIXTURES FOR RAISING QUALITY PLANTING MATERIAL OF LITCHI IN POLYBAGS

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ABSTRACT
Litchi is highly paying fruit crops if it grows scientifically. Therefore the present investigation was taken to increase the survival of air-layers in nursery and to propagate quality planting material of superior clones of litchi with increase vigour and growth inorder to meet the requirement of air-layered plants for its area expansion in the country. The present investigation entitled "Evaluation of alternate potting media mixtures for raising quality planting material of litchi in polybags". From the foregoing discussion it can be concluded that among different growing media Riverbed soil + Vermi-compost (2:1) + NPK (5g/sapling) or Riverbed soil + Vermi-compost (2:1) + Vermiculite (50g/sapling) was identified as best potting media for mass propagation of litchi in black polyethylene bags under net house for obtaining maximum survival, collar girth, sapling height, number of leaves and number of leaflets at 8 months of planting. Similarly maximum fresh weight, dry weight of shoots, higher root colonization of secondary and tertiary roots, fresh plant biomass, dry plant biomass and fresh root shoot ratio were recorded in River bed soil + Vermi-compost (2:1)+ NPK (5g/sapling) whereas, dry root shoot ratio was highest in River bed soil + Vermi-compost (2:1). From above studies, potting media containing Riverbed soil + Vermi-compost (2:1) + NPK (5g/sapling) or Riverbed soil + Vermi-compost (2:1) + Vermiculite (50g/sapling) was found most suitable alternate potting media mixtures under net house.

INTRODUCTION

Litchi production and productivity is affected by number of factors in which unavailability of quality planting material of selected variety is highly important one for better establishment after transplanting in the field. Litchi is commercially propagated by vegetative means through air-layering using local potting media. This propagation techniques lead to high mortality in the nursery and thus final survival is very less. Propagation of healthy, vigorous and genuine planting material is combination of art and science, which need proper potting media with advanced technique and technological skill. The potting medium should be high in organic matter which provide sufficient nutrient with holding sufficient moisture content and have good drainage to growing saplings in nursery. Zee *et al*. (1999) found that the young litchi roots are very brittle and careful handling is critical during planting. A potting media of equal parts soil, compost and black cinder is good for litchi air-layers having high organic matter with good drainage. In general the nursery bed soil/ poly bags mixture have poor nutrient content and transplanted saplings become weak in few months of its transplanting. Saplings lose their vigor and luster due to improper potting medium and even weak air-layers failed to establish in the main field. Production of quality planting material with vigorous growth is first step in achieving production and productivity in litchi. Raising of seedling in poly bags was introduced in 1969 in Ivory Coast (Wuidart, 1981) superseding the techniques of conventional field nursery for production of vigorous seedlings. Their advantages and disadvantages in planting programme have been well documented (Reddy *et al.*, 2006 and Kumar *et al.*, 2011).

The commonly recommended media are top soil mixed with sand and FYM in 1:1:1 ratio for raising the litchi air-layers. A study conducted by Reddy *et al*. (2001) at CPCRI, Kasaragod, Kerala on alternative media indicated that potting mixture containing sand + vermi-compost in 3:1 ratio or sand + PK fertilizers (15g/bag) + bio-fertilizers were similar in response to the conventional potting media in terms of seedling growth, physiological parameters and final seedling vigor in coconut. The effect of bio-fertilizers not only helps growth of seedlings in poly bags but, also result in better establishment of microbial population in main field, which helps in better growth and establishment of seedlings. In Sri Lanka, a potting mixture containing 3 parts of cowdung and 1 part of coir dust was shown to be the best (Perera *et al*., 1996). Polybag nursery is preferred in comparison to conventional field nursery as intensive care and maintenance of individual seedlings resulted in vigorous seedling with better root system, which attain rapid reproductive development (Krishanakumar and Reddy, 2006). Air-layering is commercial propagation method of litchi, using sand, soil and FYM in ratio of 1:1:1 as potting mixture for polybag or nursery bed in partial shed or open field condition. This propagation techniques lead to mortality of large number of saplings in the nursery during uprooting time thus final establishment is reported very less. In general, the nursery bed soil/ poly bags mixture have poor nutrient content and transplanted saplings become weak in few months of its transplanting. Therefore, the present study was

undertaken to standardize the proper potting mixture for its utilization in nursery as a mixture substrate for growing quality planting material in large scale in black poly bag under net house with higher survival and their growth parameters.

MATERIALS AND METHODS

A Nursery experiment was formulated with different potting mixtures substrate with a purpose for standardizing the ideal potting media combination for its use in large scale propagation of litchi planting material during 2009-11at National Research Centre on Litchi, Muzaffarpur, Bihar. Altogether ten different treatments viz. Potting media PM_1 - Soil + Sand + FYM (1:1:1); PM_2- Soil + Sand + FYM (1:1:1) + NPK(5g) ; PM_3- Soil + Sand + Vermi- compost (VC) (1:1:1); PM_4- Soil + Sand + Vermi-compost(1:1:1) + NPK ; PM_5- Riverbed soil (RBS) + FYM (2:1); PM_6- Riverbed soil (RBS) + FYM (2:1) + NPK(5g); PM_7- Riverbed soil + Vermi-compost (2:1); PM_8- Riverbed soil (RBS) + VC (2:1) + NPK(5g); PM_9- Riverbed soil (RBS) + VC (2:1) + Vermiculite (50g/bag) and PM_{10}- Riverbed soil (RBS) + VC (2:1) + Perlite (50g/bag). The quantity of NPK was 5g each in form of NPK (Di-ammonium phosphate, urea and murate of potash) were applied in each saplings after 01 month of planting in two split dose 2.5g each time and the vermiculite and perlite was added @ 50g/ polyethylene bag at the time of media mixture preparation. Uniformly dried and crushed coconut coir pith were added @50g per polyethylene bag during potting media preparation. The potting media mixtures were prepared in one week advance for each treatment separately and kept distinctly. Sufficient quantities of potting mixture were prepared after thorough mixing (5-6 times) in order to fill 220 number of polyethylene bags (approximately 3 kg capacity). Half of the bags were filled with mixtures before planting and remaining half portion was filled after putting the air-layers in middle portion and compress from the side for complete contact with mixtures and water immediately with watering can. Misting was given 3-4 times daily for proper humidity inside the net house. In each block there were 50 numbers of saplings/ treatments were arranged in a Completely Randomized Design (CRD) with four blocks (replication) and altogether 200 saplings in each treatment were raised for three years (2009-11). Sufficient numbers of uniform size air-layered were propagated from the mother block of the Centre cultivar Shahi adopting the standard procedure. The air-layered saplings were detached in the 1st week of October from mother plants in the morning hour and soon 70% leaf defoliated and planted in the polyethylene bags and kept in the net house condition having misting facility. Detached air-layers were dipped in Carbendazim (0.02% solution) for 2-3 minute soon after removal of polyethylene cover for avoiding any pathogenic contamination. Filled polyethylene bags were kept in the agro shed net house having the misting facility. All due care were taken to raise healthy and vigorous saplings. Need based inter-culturing, hoeing and plant protection measures were adopted for raising healthy and vigorous saplings. Observation on growth parameters such as sapling height, girth at collar, number of leaves/ seedling, number of leaflets/ leaf at 8th months, above ground fresh weight (FW), dry matter (DM), dry weight (DW); dry weight of primary, secondary and tertiary root for each treatments. The root length was measured by totaling the primary, secondary and tertiary roots length together for each treatment. Root shoot ratio (fresh and dry weight) and available leaf nutrient content (NPK) were also done for each treatment. Survival percentages of the plants under each treatment were recorded at 8th month after planting. The leaf samples were collected from 3rd pair of leaflet of previous flush at 8th month, oven dried and grinded. The powdered fraction of leaf samples was digested in diacid (HNO_3 + $HClO_4$ 3:1) and analyzed for phosphorus and potassium content (Jackson, 1973). Nitrogen content in plant samples was estimated according to modified Kjeldahl procedure as described by Jackson (1973) using Pelican Kel Plus Auto analyzer (Metrohm 877 Titrino Plus).

RESULTS AND DISCUSSION

Seedling vigor

Results (Table 1) revealed that air-layers growth in terms of sapling height, collar girth, number of leaves and number of leaflets at 8 months after planting in polyethylene bags during all year varied significantly among different potting mixtures. Sapling height was significantly higher (66.45cm) in PM_8 (RBS + VC + NPK) *i.e.* Riverbed soil (RBS) + VC (2:1) + NPK (5g/ sapling) with their corresponding values (69.85, 72.60 and 56.90 cm) during 2009-11. However, this treatment was at par with treatment PM_9 (RBS + VC + Vermiculite), follwed by PM_3 (Soil + Sand + VC), PM_2 (Soil + Sand + FYM + NPK). The collar girth also varied significantly over the years and thier average value was highest (4.06cm) in PM_8 (RBS + VC + NPK)

Table 1: Effect of different potting media on litchi sapling height and collar girth grown in polybag in net house at 8th month

Treatment	Treatment details	Sapling height (cm)				Collar girth (cm)			
		2009	2010	2011	Average	2009	2010	2011	Average
PM_1	Soil + Sand + FYM	50.95	46.00	53.80	50.25	2.80	3.43	3.43	3.22
PM_2	Soil + Sand + FYM + NPK	48.89	62.00	53.50	54.80	3.12	3.23	3.72	3.36
PM_3	Soil + Sand + VC	58.58	63.20	46.00	55.93	3.40	3.40	3.88	3.56
PM_4	Soil + Sand + VC + NPK	50.10	50.80	51.25	50.72	3.44	3.60	3.75	3.60
PM_5	RBS + FYM	62.75	42.00	50.65	51.80	3.04	3.93	3.57	3.51
PM_6	RBS + FYM + NPK	56.00	47.40	48.80	50.73	3.10	3.73	3.75	3.53
PM_7	RBS + VC	57.85	46.00	45.60	49.82	3.20	3.93	3.69	3.61
PM_8	RBS + VC + NPK	69.85	72.60	56.90	66.45	4.16	3.90	4.11	4.06
PM_9	RBS: VC + Vermiculite	65.45	65.60	55.70	62.25	3.48	3.93	3.94	3.78
PM_{10}	RBS + VC + Perlite	61.75	49.60	52.35	54.57	3.12	3.65	3.64	3.47
	CD 5%	5.16	5.76	5.44		2.70	NS	0.33	

PM - Potting media, FYM - Farm Yard Manure, NPK applied @5g each/sapling, VC- Vermi-compost, RBS - Riverbed soil, Vermiculite @50g each/sapling and Perlite @50g each/sapling.

Table 2: Effect of different potting media on litchi sapling number of leaves and leaflets grown in polybag in net house at 8th month

Treatment	Treatment details	Number of leaves/ saplings				Number of leaflets/saplings			
		2009	2010	2011	Average	2009	2010	2011	Average
PM_1	Soil + Sand + FYM	3.70	6.00	4.15	4.62	28.00	15.05	17.30	20.12
PM_2	Soil + Sand + FYM + NPK	2.95	12.40	4.95	6.77	41.00	15.25	18.95	25.07
PM_3	Soil + Sand + VC	2.90	13.80	5.00	7.23	42.40	14.30	21.20	25.97
PM_4	Soil + Sand + VC + NPK	3.90	9.40	4.80	6.03	37.60	19.80	18.75	25.38
PM_5	RBS + FYM	4.60	9.20	4.95	6.25	27.20	20.20	21.50	22.97
PM_6	RBS + FYM + NPK	3.60	6.60	4.55	4.92	30.40	16.20	18.85	21.82
PM_7	RBS + VC	3.60	11.80	4.75	6.72	34.20	16.15	18.05	22.80
PM_8	RBS + VC + NPK	5.20	17.00	5.95	9.38	58.40	24.90	24.15	35.82
PM_9	RBS: VC + Vermiculite	4.60	13.20	5.40	7.73	48.80	22.10	22.50	31.13
PM_{10}	RBS + VC + Perlite	3.55	5.80	5.35	4.90	27.40	17.40	21.90	22.23
	CD 5%	0.82	2.24	0.92		3.97	3.37	4.48	

PM - Potting media, FYM - Farm Yard Manure, NPK applied @5g each/sapling, VC- Vermi-compost, RBS - Riverbed soil, Vermiculite @50g each/sapling and Perlite @50g each/sapling.

Table 3: Growth, dry matter accumulation and root shoot ratio in litchi saplings grown in polybag under net house as influenced by different potting media at 8th month

Treatment	Treatment details	Shoot wt (g)		Leaves wt (g)		Root wt (g)		Root length (cm)	Total plant biomass (g)		Root / shoot ratio	
		Fresh	Dry	Fresh	Dry	Fresh	Dry		Fresh	Dry	Fresh	Dry
PM_1	Soil + Sand + FYM	28.65	23.00	23.03	3.66	30.84	7.96	295.38	82.52	34.62	0.60	0.30
PM_2	Soil + Sand + FYM + NPK	32.61	25.94	26.44	4.13	47.35	11.57	409.20	106.40	41.64	0.80	0.38
PM_3	Soil + Sand + VC	32.27	23.27	18.29	2.59	31.62	10.22	385.88	82.18	36.08	0.63	0.40
PM_4	Soil + Sand + VC + NPK	42.26	30.01	27.61	6.23	48.67	9.76	512.25	118.54	46.00	0.70	0.27
PM_5	RBS + FYM	28.30	15.02	19.13	2.63	30.38	7.04	440.63	77.81	24.69	0.64	0.40
PM_6	RBS + FYM + NPK	35.34	23.83	21.35	2.90	39.13	8.81	428.50	95.82	35.54	0.69	0.33
PM_7	RBS + VC	32.92	22.74	32.13	6.07	41.08	12.56	462.50	106.13	41.37	0.63	0.44
PM_8	RBS + VC + NPK	44.96	32.86	27.00	7.82	59.00	12.99	630.08	130.96	53.67	0.82	0.32
PM_9	RBS: VC + Vermiculite	44.26	32.22	24.74	7.53	53.01	12.60	627.38	122.01	52.35	0.77	0.32
PM_{10}	RBS + VC + Perlite	32.61	22.66	27.26	4.56	42.58	10.32	452.75	102.45	37.54	0.71	0.38
	CD at 5%	2.95	1.43	1.51	0.37	3.29	1.69	51.29	8.36	4.09	0.09	0.06

PM - Potting media, FYM - Farm Yard Manure, NPK applied @5g each/sapling, VC- Vermi-compost, RBS - Riverbed soil, Vermiculite @50g each/sapling, Perlite @50g each/sapling, wt- weight, DM- Dry matter, FW- fresh weight and DW- Dry weight

Table 4: Leaf nutrient content and survival of litchi saplings grown in polybag as influenced by different potting media at 8th month

Treatment	Treatment details	Leaf nutrient content (%)			Survival percentage of saplings			
		N	P	K	2009	2010	2011	Average
PM_1	Soil + Sand + FYM	1.18	0.13	1.68	54.50 (47.6)	55.50 (48.2)	75.00 (60.0)	61.67
PM_2	Soil + Sand + FYM + NPK	1.33	0.15	1.89	55.00 (47.9)	57.00 (49.0)	64.00 (53.1)	58.67
PM_3	Soil + Sand + VC	1.31	0.14	2.00	60.50 (51.1)	63.50 (52.8)	87.50 (69.3)	70.50
PM_4	Soil + Sand + VC + NPK	1.37	0.16	2.00	60.50 (51.1)	68.00 (55.6)	65.50 (54.0)	64.67
PM_5	RBS + FYM	1.24	0.15	2.00	58.00 (59.6)	69.00 (56.2)	95.00 (77.1)	74.00
PM_6	RBS + FYM + NPK	1.28	0.18	2.10	58.00 (59.6)	64.00 (53.1)	50.50 (45.3)	57.50
PM_7	RBS + VC	1.36	0.19	2.04	66.00 (54.3)	60.00 (50.8)	82.50 (56.3)	69.50
PM_8	RBS + VC + NPK	1.48	0.20	2.16	72.00 (58.0)	70.00 (56.8)	87.50 (69.3)	76.50
PM_9	RBS: VC + Vermiculite	1.39	0.19	2.14	74.50 (59.7)	79.00 (62.7)	97.50 (80.9)	83.67
PM_{10}	RBS + VC + Perlite	1.32	0.18	2.08	68.50 (55.9)	69.00 (56.2)	97.00 (80.0)	78.17
	CD 5%	0.11	NS	0.13	5.12	5.21	4.64	

PM - Potting media, FYM - Farm Yard Manure, NPK applied @5g each/sapling, VC- Vermi-compost, RBS - Riverbed soil, Vermiculite @50g each/sapling and Perlite @50g each/sapling. Values in parenthesis are Inverse sine √Percentage transformation.

followed by PM_9 (RBS + VC + Vermiculite) 3.78cm .The poor performance of sapling growth was in PM_1 and PM_2 could be due to insufficient organic matter content and moisture holding capacity of the mixture along with low level of leaf N content. The number of leaves and number of leaflets per sapling differed significantly in every year and were higher (9.38 and 35.82 respectively) in teatment PM_8 (RBS + VC + NPK). However, number of leaves and number of leaflets per sapling in PM_9 (RBS + VC + Vermiculite) and PM_3 (Soil + Sand + VC) were at par with thier corresponding values 7.73 and 7.23 and 31.13 and 25.97, respectively. The result (Table1 and 2) indicated that sapling raised in PM_8 (RBS + VC + NPK) and PM_9 (RBS + VC + Vermiculite) were superior to those grown in other potting mixture in terms of morphological growth parameters such as height, collar girth, number of leaves and number of leaflets of each air-layers may be due to general improvement in physical and chemical properties of the potting media (Singh *et al.*, 2000). Similar results were also reported by Kumar *et al*. (2011) in litchi (*Litchi chinensis* Sonn) and Prasana *et al*. (2013) in mango (*Mangifera indica* L.).

Plant biomass

The total plant biomass production of litchi saplings grown in polybag was significantly influenced by different potting media

treatment (Table 3). The higher total plant biomass (fresh and dry) 130.96 and 53.67g was recorded in PM_8 (RBS + VC + NPK) followed by PM_9 (RBS + VC + Vermiculite) and PM_4 (Soil + Sand + VC + NPK) with their values 122.01 and 52.35g and 118.54 and 46.00g, respectively. Similarly, the fresh shoot weight (44.96g) and leaves weight (32.86g) were also observed higher in the same treatment i.e. PM_8 (RBS + VC + NPK) which was at par with PM_9 (RBS + VC + Vermiculite) with thier values (44.26g) and (32.22g), respectively. Despite the fact that air-layers contains some amount of resserve material in thier shoot for forcing the cut air-layers for rooting and initial sprouting of flush, it has been shown that growth and vigor of seedlings can be improved through addition of fertilizer (Reddy *et al*., 2006; Singh *et al*., 2000; Prasana *et al*., 2013).

The root length (secondary and tertiary) was significantly higher (630.00cm) in PM_8 (RBS + VC + NPK) closely followed by 627.38cm in PM_9 (RBS + VC + Vermiculite) while, lowest root length (295.38cm) was measured in PM_1 (Soil + Sand + FYM). The dry weight of root was significantly higher in RBS + VC + NPK (12.99g) cosely followed by RBS + VC + Vermiculite (12.60g), RBS + VC (12.56g) and Soil + Sand + FYM + NPK (11.57g). The root dry matter in potting mixture Soil + Sand + FYM (7.96g) was on par with RBS + FYM (7.04), RBS + FYM + NPK (8.81g) and Soil + Sand + VC + NPK (9.76g) treatments. Treatments with RBS + VC + NPK and RBS + VC + Vermiculite resulted in increased root growth, especially feeder roots to absorb moisture and nutrients may be due to presence of beneficial micro-organism and thier assoiciation in positive effects of growth promoting and release of substances due to conginial environment.

Root-shoot ratio

The ratio of root and shoot on fresh weight basis was significantly higher in PM_8 (0.82) closely followed by Soil + Sand + FYM + NPK (0.80) and RBS + VC + Vermiculite (0.77). The lowest (0.60) root shoot ratio was in PM_1 (Soil + Sand + FYM) which was at par with PM_3, PM_5 and PM_7 treatments (Table 3). The ratio of root to shoot on dry weight basis was also differed significantly due to potting media. The higher ratio was recorded in PM_7 (0.44) followed by PM_3 and PM_5 (0.40 each) treatments. Despite the fact that root shoot ratio (fresh and dry weight basis) gave an indication about the overall growth of sapling health, photosynthetic activity, root growth and proper nutrient utilization which may be converted into root and shoot development. This could be due to better nutritional availability leading to higher production of photosynthetic leaves in these treatments, finally higher accumulation of phtosynthates in morphological growth components. Thus the air-layers/ saplings showed higher vigor in terms of sapling height, number of leaves, girth and total plant biomass. The sapling raised in sand media had reduced vigor as indicated by the growth components in terms of sapling height, number of leaves, girth and root length. Reddy *et al*. (2001) and Poulter and Eberhard (2008) also noticed reduced seedling vigor in terms of height, girth and number of leaves in sand media in polybag.

Leaf nutrient contents

Leaf N content was significantly higher in PM_8 (1.48%) followed by RBS + VC + Vermiculite (1.39%), Soil + Sand + VC + NPK (1.37%) and RBS + VC (1.36%) compared to Soil + Sand + FYM (1.18%). Leaf K content was lowest in Soil + Sand + FYM (1.68%) compared to RBS + VC + NPK (2.16%), RBS + VC + Vermiculite (2.14%) and RBS + FYM + NPK (2.10%). Larger root system might have further assisted in efficient moisture and nutrient absorption and hence, higher nutrient content in leaf in these treatments. Leaf P concentration did not vary significantly due to treatments (Table 4). However, saplings grown in RBS + VC recorded higher leaf P (0.20%) compared to other treatments. These results are in close agreement with Sharma *et al*. (2013) revealed that application of organic and inorganic fertilizers resulted in reduced respiration and transpiration in plant.

Survival percentage

The maximum overall survival (83.67%) was recorded in RBS + VC + Vermiculite (PM_9) media among different treatments and closely followed by RBS + VC + Perlite (78.17%) and RBS + VC + NPK (76.50%). The lowest survival percentage was recorded in PM_6 (58.67%), which was at par with PM_2 58.67 % and PM_1 61.67% (Table 4). This may be due to favorable potting media for better growth of the saplings particularly for good development of root system coupled with morphological growth of the saplings. These results are in close agreement with Prasana *et al*. (2013) and Shamet *et al*. (1994).

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