AJH
eISSN- 0976-724X

THE ASIAN JOURNAL OF HORTICULTURE
Volume **10** | Issue 2 | December, 2015 | 257-261
Visit us -*www.researchjournal.co.in*

RESEARCH PAPER

DOI : 10.15740/HAS/TAJH/10.2/257-261

***Article history* :**
Received : 13.10.2015
Revised : 06.11.2015
Accepted : 19.11.2015

Effect of different growing media on survival and growth of transplanted litchi layers

■ **WINEET CHAWLA AND KULDEEP MEHTA[1]**

Members of the Research Forum

Associated Authors:
[1]Department of Fruit Science, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, SOLAN (H.P.) INDIA

Author for correspondence :
WINEET CHAWLA
Department of Agriculture, Baba Farid College, BATHINDA (PUNJAB) INDIA
Email : wineetchawla@gmail.com

ABSTRACT : A field experiment was conducted to study effect of different growing media on survival and growth of transplanted litchi layers at the Horticultural Regional Research Station, Dhaulakuan, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan Himachal Pradesh during the year 2011-2012. The results indicated that litchi orchard soil + FYM + PGPR @ 50g/kg growing media took earlier growth emergence after planting (105.98 days) and also gave better results with respect to all the parameters studied including survival percentage (90.00%), increase in plant height (10.65 cm), number of leaves/layer (32.30), average leaf area (25.50 cm^2), total leaf area (823.45 cm^2), total root length (14.27 m), chlorophyll content (0.91 mg/g), fresh and dry weight of roots (8.17 and 3.08 g), fresh and dry weight of shoot (58.03 and 35.30 g), root: shoot ratio on fresh and dry weight basis (0.141 and 0.087), respectively.

KEY WORDS : PGPR, Growing media, Litchi layers

HOW TO CITE THIS ARTICLE : Chawla, Wineet and Mehta, Kuldeep (2015). Effect of different growing media on survival and growth of transplanted litchi layers. *Asian J. Hort.*, **10**(2) : 257-261.

Litchi is a subtropical fruit of commercial importance and demarcated as a crop having high export potential. Litchi fruit has gained popularity as an exotic fruit and that is why demand of planting material of litchi is increasing tremendously. Limited availablity of quality planting material is the main cause of low expansion of area under litchi cultivation. Air layering is the most common and convenient method of propagation (Bhambota *et al*., 1968). Nevertheless, the major bottleneck associated with this method of propagation is varying degree of success of air layering, the high mortality of layers after severing them from the mother plant and establishment of their own root system in nursery. Thus, it restricts the availability of propagules of elite genotypes of litchi (Sharfuddin and Husain, 1983 and Sharma *et al*., 1990).

A variety of materials and mixture of materials are used in horticulture as growing media such as peat products, wood products, composts, mineral fibres, mineral particles, synthetic foams, synthetic fibres and organic fibres, which are more or less suitable growing media. Selected physical aspects of growing media like bulk density, total pore volume, structural stability, root resistance, water retention, rewetting, hydrophobicity, water transport and oxygen transport related to plant growth requirements, are used to discuss the suitability of growing media for plant growth. However, more information regarding growing media, ways to overcome higher mortality rate and improving the survival rate of litchi air layers needs to be generated. It was hypothesized that use of suitable growing medium will help in the production of quality planting material with better root system of air-layers and final survival of litchi air layers in the nursery. This will further help in lowering the cost of planting material which in turn, will be beneficial for the farmer. Keeping the above difficulties and constraints in view, the present investigations were carried out with the objective to study the effect of growing media on survival and growth of transplanted litchi layers.

RESEARCH METHODS

The rooted layers were obtained from the litchi 'Calcuttia' mother block maintained at the experimental farm of Horticultural Regional Research Station, Dhaulakuan, Himachal Pradesh. The experiment was laid out in Randomized Block Design (RBD) with eight treatments, replicated thrice and each replication consisted of fifty layers. Eight growing media *viz.*, (M_1) soil + sand + FYM (1:1:1, v/v), (M_2) litchi orchard soil + sand + FYM (1:1:1, v/v), (M_3) litchi orchard soil + sand + vermicompost (1:1:1, v/v), (M_4) litchi orchard soil + cocopeat + vermicompost (1:1:1, v/v), (M_5) litchi orchard soil + woodchip + FYM (1:1:1, v/v), (M_6) litchi orchard soil + FYM (1:1) + PGPR@50g/kg, (M_7) soil + FYM (1:1) + PGPR@50g/kg and soil (control) were prepared after thorough mixing of the ingredients at the experimental farm. Litchi orchard soil was collected from 10-15cm depth from old litchi trees. The cocopeat bricks were soaked in water to make coir dust. Plant growth promoting rhizobacteria (PGPR) strain *viz.*, *Bacillus licheniformis* CKAI was procured from the Department of Microbiology, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni. The prepared mixtures of the various growing media were filled in plastic polybags (30 x 15 cm^2) and kept under shade net house.

RESEARCH FINDINGS AND DISCUSSION

The litchi layers planted in poly-bags containing growing media of different combinations had great significant effect on root and shoot characteristics of rooted layers. The higher survival percentage (90.00%) of transplanted rooted layers and minimum number of days to initiate growth after planting (105.98 days) were recorded with growing media consisting litchi orchard soil + FYM (1:1) + PGPR@50g/kg, which was statistically at par with media containing soil + FYM (1:1) + PGPR @ 50g/kg and media containing litchi orchard soil + cocopeat + vermicompost whereas minimum survival percentage (58.67%) and maximum number of days to initiate growth after planting (131.94 days) were obtained with control (Soil) (Table 1). This might be due to the reason that media containing FYM as one of the constituents provided a start for establishment of rooted layers which further got supplemented by PGPR's. Plant growth promoting rhizobacteria encourage beneficial effect on plant health and growth and accelerate the availability of nutrients and assimilates as well as the production of substances promoting plant growth. The PGPR strains may increase the level of root hormone by production of IAA, cytokinin and other plant hormones.

Many plant-associated bacteria have the ability to produce plant growth regulators especially, indole-3-acetic acid which further play an important role in plant growth promotion (Patten and Glick, 2002; Khalid *et al*., 2004). PGPR strains significantly affected plants growth and development by biological nitrogen fixation, increasing inorganic phosphate solubilization of organic phosphorus compounds, affecting Fe adsorption with siderophore production and by affecting the uptake, absorption and translocation of miconutrients (Esitken *et al*., 2003; Cakmakci *et al*., 2006 and Aslantas *et al*., 2007) and hence better survival percentage. Further wide spread occurance of Arbuscular Mycorrhizae (AM) endosymbionts in litchi orchard soil may have promoted better uptake of nutrients particularly P by planted litchi layers.

The media comprising of litchi orchard soil + FYM (1:1) + PGPR@50g/kg exhibited maximum increase (10.65 cm) in plant height and proved numerically superior to soil + FYM (1:1) + PGPR@50g/kg (Table 1). The present findings get support from the observation of Putulndriyani *et al.* (2011) who also observed that the media consisting of soil + manure (1:1) gave higher growth of the pineapple seedlings. This might be due to addition of PGPR which enhance the availability and uptake of plant nutrients, the production of growth promoting substance and the suppression of deleterious bacteria which might have encouraged the rooted layers to put on better vegetative growth and hence an increase in plant height. Enhanced microbial activity in the plant rhizosphere could have the acquisition of mineral nutrients either directly via mobilization or indirectly via effect on root morphology and physiology (Babalola, 2010; Dobbelaere *et al*., 2003; Vessey, 2003; Lucy *et al*., 2004 and Compant *et al*., 2005)

Highest number of leaves and total leaf area (32.30 and 823.45 cm^2) per rooted layer were recorded in media of litchi orchard soil + FYM (1:1) + PGPR @ 50g/kg, whereas the lowest number of leaves, and total leaf area (20.07 and 428.83 cm^2) were recorded in control. Increase in these parameters of leaf might be due to the effect of PGPR and arbuscular mycorrhizae present in the litchi orchard soil. PGPR interaction with arbuscular mycorrhizae fungi produced positive effects for development activities involved in plant growth promotion

(Behl *et al.*, 2003; Xavier and Germida, 2003). These results are in conformity with the findings of Karakurt and Aslantas (2010) who also observed increased leaf number as well as area by the PGPR inoculation.

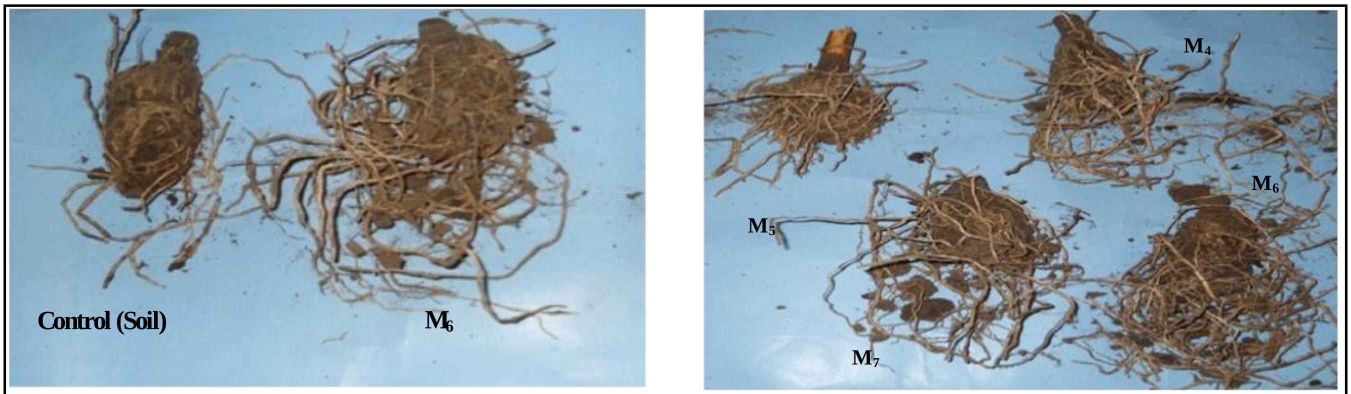
The highest chlorophyll content (0.91 mg/g) was recorded in treatment M_6 containing litchi orchard soil + FYM (1:1) + PGPR @ 50g/kg (Table 1). These results are in agreement with the finding of Amir *et al.* (2005)

Table 1 : Effect of different growing media on growth emergence and its associated characters of transplanted litchi layers

Treatments	Media (v/v)	Survival percentage	Growth emergence after planting (days)	Increase in plant height (cm)	Number of leaves/ layer	Total leaf area (cm^2)	Chlorophyll content (mg/g)
M_1	Soil + Sand + FYM (1:1:1)	73.33 (58.91)	126.26	5.56	22.93	508.69	0.73
M_2	Litchi orchard Soil + Sand + FYM (1:1:1)	77.33 (61.56)	124.42	5.99	25.00	569.69	0.79
M_3	Litchi orchard Soil + Sand + Vermicompost (1:1:1)	84.00 (66.50)	118.02	6.97	27.27	653.53	0.79
M_4	Litchi orchard Soil + cocopeat + vermicompost (1:1:1)	86.67 (68.70)	109.94	8.47	30.63	761.79	0.83
M_5	Litchi orchard soil + woodchip + FYM (1:1:1)	83.33 (65.99)	119.19	6.81	27.87	678.56	0.78
M_6	Litchi orchard Soil + FYM (1:1) + PGPR@50g/kg	90.00 (71.73)	105.98	10.65	32.30	823.45	0.91
M_7	Soil + FYM (1:1) + PGPR@50g/kg	87.33 (69.31)	108.53	10.11	30.57	757.18	0.87
M_8	Control (Soil)	58.67 (49.98)	131.94	4.73	20.07	428.83	0.70
	C.D. (P=0.05)	4.77	4.21	1.13	1.75	72.92	0.11

Table 2 : Effect of different growing media on total root length, root and shoot biomass characters of transplanted litchi layers

Treatments	Total root length (m)	Fresh weight of roots (g)	Dry weight of roots (g)	Fresh weight of shoot (g)	Dry weight of shoot (g)	Root: shoot ratio (on fresh weight basis)	Root: shoot ratio (on dry weight basis)
M_1	8.30	5.12	2.01	50.20	29.23	0.102	0.069
M_2	8.83	5.70	2.12	51.13	30.47	0.112	0.070
M_3	10.17	5.92	2.44	52.93	31.23	0.112	0.078
M_4	12.40	7.39	2.69	55.57	33.13	0.133	0.082
M_5	10.33	6.20	2.38	51.27	31.17	0.121	0.076
M_6	14.27	8.17	3.08	58.03	35.30	0.141	0.087
M_7	12.97	7.62	2.79	55.33	33.50	0.138	0.084
M_8	6.90	4.20	1.32	46.50	24.90	0.090	0.053
C.D. (P=0.05)	1.21	0.77	0.54	3.34	4.51	0.017	0.016



(A) (B)

Plate 1 : Effect of different growing media on rooting of transplanted layers

who observed the effect of PGPR's inoculation on enhanced nutrient accumulation and plant growth of oil palm seedlings and reported enhanced leaf chlorophyll content of the host plant by application of PGPR's in growing media. This might be due to the higher N accumulation by bacterial N_2 fixation and better root growth, which may have promoted greater uptake of water and nutrients. The higher N incorporation apparently increased the formation of protein and enzyme for better physiological activities and also to the formation of chlorophyll, which consequently, increased the photosynthetic activity (Mia *et al.*, 2005).

Maximum total root length was found to be 14.27 m with litchi orchard soil + FYM (1:1) + PGPR@50g/kg, which was significantly higher than other treatments, while minimum total root length (6.90 m) was observed in control and was significantly lower than all other treatments (Table 2, Plate 1). These might be due to PGPR acting as biofertilizers by directly helping to provide nutrient to the host plant, or indirectly by positively influencing root growth and morphology or by aiding other beneficial symbiotic relationships. Indole-3-acetic acid is a phytohormone and is known to be involved in root initiation, cell division and cell enlargement (Salisbury, 1994). This hormone is very commonly produced by PGPR (Barazani and Friedman, 1999). IAA-producing PGPR are believed to increase root growth and root length, resulting in greater root surface area which enables the plant to absorb more nutrients from the soil. Beside these, PGPR is able to exert a beneficial effect on increase in root growth and weight (Nelson, 2004). Various research findings have shown that application of PGPR on cuttings of different plant species showed genotype dependent rooting and increased root growth (Mafia *et al*., 2007 and Zhang *et al*., 2007). According to Patten and Glick (2002) IAA producing *Pseudomonas putida* increased the length of canola seedling on an average of 35 and 50 per cent.

Highest fresh and dry weight of roots (8.17 g and 3.08 g) was achieved with media consisting litchi orchard soil + FYM (1:1) PGPR@50g/kg, whereas lowest was recorded with control (Soil). Similar observation(s) have also been reported by several investigators by the application of PGPR in growing media. The results are supported by the findings of Amir *et al.* (2005) in oil palm, Baghel *et al*. (2004) in phalsa, Mia *et al*. (1998) in banana and Lavania *et al*. (2006) in betalvine.

Fresh and dry weight of shoot was influenced by various growing media (Table 2). The highest fresh and dry weight of shoot was recorded with litchi orchard soil + FYM (1:1) + PGPR@50g/kg (58.03 g and 35.30 g) and minimum (46.50 and 24.90 g) was noted in control (Soil). The better root system of rooted layers may have enhanced the rates of water and mineral nutrient uptake, hence resulted in increased fresh weight of shoot (Okon and Kapulnik, 1986). These results are corroborated by the findings of Rodriguez *et al*. (2005) who observed maximum total fresh and dry weight with the application of mycorrhizal fungi and PGPR in banana.

Maximum root: shoot ratio (on fresh and dry weight basis) was recorded with media containing litchi orchard soil + FYM (1:1) + PGPR@50g/kg (0.141 and 0.087, respectively) and minimum root: shoot ratio was observed in control (0.090 and 0.053). Increased root length and total growth by PGPR application probably resulted in greater root surface area which may have enabled the plant to access more nutrients from the soil. The rooted layers were benefited by the improved root development with subsequent increase in rates of water and mineral nutrient uptake, thereby an increase in root: shoot ratio, both on fresh and dry weight basis.

REFERENCES

Amir, H.G., Shamsuddin, Z.H., Halimi, M.S., Marziah, M. and Ramlan, M.F. (2005). Enhancement in nutrient accumulation and growth of oil palm seedlings caused by PGPR under field nursery conditions. *Communi. Soil Sci. & Plant Analysis,* **36** (15/16) : 2059-2066.

Aslantas, R., Cakmakci, R. and Sahin, F. (2007). Effect of plant growth promoting rhizobacteria on young apples trees growth and fruit yield under orchard conditions. *Sci. Hort.,* **111** (4) : 371-377.

Babalola, O.O. (2010). Beneficial bacteria of agricultural importance. *Biotechnol. Letter,* **32** : 1559-1570.

Baghel, B.S., Yadav, R., Tiwari, R. and Gupta, N. (2004). Response of phalsa (*Grewia subinaequalis* DC) cuttings to biofertilizers and rooting media. *Indian J. Hort.,* **61**(1): 89-91

Barazani, O. and Friedman, J. (1999). Is IAA the major root growth factor secreted from plant-growth-mediating bacteria? *J. Chem. Ecol*., **25**: 2397–2406.

Behl, R.K., Sharma, H., Kumar, V. and Narula, N. (2003). Interaction amongst mycorrhiza, *Azotobacter chroococcum* and root characteristics of wheat varieties. *J. Agron. Crop Sci.,* **189** : 151-155.

Bhambota, J.R., Singh, K.K. and Saini, H. (1968). Propagation litchi plant. *Punjab Hort. J.,* **8** : 200-203

Cakmakci, R., Donmez, F., Aydin, A. and Sahin, F. (2006). Growth promotion of plants by plant growth-promoting rhizobacteria under greenhouse and two different field soil condition. *Soil Biol. Biochem.,* **38** : 1482-1487.

Compant, S., Duffy, B., Nowak, J., Clement, C. and Essaid, A.B. (2005). Use of plant growth promoting bacteria for biocontrol of plant diseases: principles, mechanisms of action, and future prospects. *Appl. Environ. Microbiol.,* **7**: 4951-4959

Dobbelaere, S., Vanderleyden, J. and Okon, Y. (2003). Plant growth-promoting effects of diazotrophs in the rhizosphere. *Crit. Rev. Plant. Sci.,* **22** : 107-149.

Esitken, A., Karlýdag, H., Ercisli, S., Turan, M. and Sahin, F. (2003). The effects of spraying a growth promoting bacterium on the yield, growth and nutrient element composition of leaves of apricot (*Prunus armeniaca* L. cv. HACÝHALILOGLU). *Australian J. Agric. Res.,* **54** : 377-380.

Karakurt, H. and Aslantas, R. (2010). Effects of some plant growth promoting rhizobacteria (PGPR) strains on plant growth and leaf nutrient content of apple. *J. Fruit & Orna. Plant Res.,* **18** (1) : 101-110.

Khalid, A., Arshad, M. and Zahir, Z.A. (2004). Screening plant growth-promoting rhizobacteria for improving growth and yield of wheat. *J. Appl. Microbiol.,* **96**: 473–480

Lavania, M., Chauhan, P.S., Chauhan, S.V.S., Singh, H.B. and Nautiyal, C.S. (2006). Induction of plant defense enzymes and phenolics by treatment with plant growth-promoting rhizobacteria *Serratia marcescens* NBRI1213. *Curr. Microbiol.,* **52**(5): 363–368.

Lucy, M., Reed, E. and Glick, B.R. (2004). Applications of free living plant growth-promoting rhizobacteria. *AVan Leeuw J. Microb.,* **86** : 1-25.

Mafia, R.G., Alfenas, A.C., Mafia, L.A., Ferreira, E.M. and Siqueira, L. (2007). Effect of rhizobacteria on rooting and growth of eucalyptus clone under different conditions of clonal propagation. *Revista Arvore,* **31**(5) : 813-821.

Mia, M.A.B., Shamsuddin, Z.H., Zakaria, W. and Marziah, M. (1998). Root stimulation and nutrient uptake of banana inoculated with *Azospirillum brasilense* and grown under hydroponic condition. In: Proc. First National Banana Seminar. Zakaria W, Mahmud T M M, Khalijah S D, Nor A M F and M. Marziah (eds.). pp. 122–133

Mia, M.A.B., Shamsuddin, Z.H., Zakaria, W. and Marziah, M. (2005). High-yielding and quality banana production through plant growth promoting rhizobacterial inoculation. *Fruits,* **60** : 179-185.

Nelson, L.M. (2004). Plant growth promoting rhizobacteria (PGPR): Prospect for inoculants. Online. *Crop Mgmt.* doi:10.1094/CM-2004-0301-05-RV.

Okon, Y. and Kapulnik, Y. (1986). Development and function of *Azospirillum*-inoculated roots. *Plant Soil,* **90** : 3-16.

Patten, C.L. and Glick, B.R. (2002). Role of *Pseudomonas putida* indoleacetic acid in development of the host plant root system. *Appl. Environ. Microbiol.,* **68** : 3795–3801

Putulndriyani, N.L., Hadiati, S. and Soemargono, A. (2011). Effect of planting medium on the growth of pineapple seedling. *J. Agric. & Biol. Sci.,* **6** (2) : 32-36.

Rodriguez-Romero, A.S., Guerra, M.S. and Jaizme-Vega, M.D. (2005). Effect of arbuscular mycorrhizal fungi and rhizobacteria on banana growth and nutrition. *Agron. Sustainable Devel.,* 25: 395–399

Salisbury, F.B. (1994). Role of plant hormones. In : *Plant environment interactions*. Wilkinson R E. (ed.). Marcel Dekker, New York, USA. pp. 39–81.

Sharfuddin, A.F.M. and Husain, A. (1983). Effect of pruning on the survivality of detached rooted air layers in litchi. *Bangladesh Hort.,* **11** : 39-40.

Sharma, S.B., Ray, P.K. and Singh, B.K. (1990). Note on rooting and survival of litchi layers. *Indian J. Hort.,* **47**(2): 174-176

Vessey, J.K. (2003). Plant growth promoting rhizobacteria as biofertilizer. *Plant Soil.,* **255** : 571-586.

Xavier, L.J.C. and Germida, J.J. (2003). Bacteria associated with *Glomus clarum* spores influence mycorrhizal activity. *Soil Biol. Biochem.,* **35** : 471-478

Zhang, Q., Li, H.B., Duo, J.G., Wang, W.F., Liu, Y.Q., Liang, H.Y. and Yang, J.M. (2007). Effect of IBA and *Agrobacterium rhizogenes* on the softwood cuttings of *Tilia mandshurica*. *Acta Hort. Sinca,* **34** (1) : 201-204.