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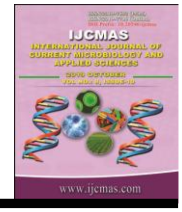

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Effect of Different Potting Media on Nutrient Composition of Soil and Leaves of Litchi Air Layers

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A B S T R A C T

During 2018-19, effects of different organic nutrient sources were tested on litchi cv. Dehradun in terms of nutrient composition of soil and leaves at Advanced Centre for Horticulture Research, Udheywalla, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu. This experiment demonstrated significant differences in the nutrient element composition of soil and leaves of litchi air layers. The maximum NPK content (294.76 kg/ha, 31.43 kg/ha and 177.42 kg/ha, respectively) of soil was recorded in media containing litchi orchard soil along with FYM and rhizobacteria whereas, the minimum NPK content (245.94 kg/ha, 8.80 kg/ha and 100.39 kg/ha, respectively) of soil was recorded in control. The NPK content of litchi leaves (1.46 %, 0.24 % and 2.16 %, respectively) was found to be significantly higher in treatment containing litchi orchard soil in combination with FYM and rhizobacteria, whereas, the minimum NPK content of leaves (1.08 %, 0.14 % and 1.45 %, respectively) was recorded in control. The results of this study suggest that rhizobacteria has the potential to increase the soil fertility as well as nutrient composition of litchi leaves which will ultimately enhance the plant growth and development as well as yield.

Introduction

Many agricultural soils of the world are deficient in one or more of the essential nutrients needed to support healthy plants. Addition of amendments is essential for a proper nutrient supply and maximum yields. The use of chemical fertilizers to enhance soil fertility and crop productivity has often negatively affected the complex system of biogeochemical cycles. Therefore, interest has grown in environmentally sustainable and organic agricultural practices (Esitken *et al.,* 2005). The beneficial effects of organic nutrients on soil fertility have been repeatedly shown, yet there are no guidelines for their management. Organic materials are not *magic*; many of their functions with respect to soil fertility are known. Organic materials influence nutrient availability (i) by adding nutrients (ii) through mineralization-immobilization patterns, (iii) as an energy source for microbial activities, (iv) as precursors to soil organic matter (SOM), and

(v) by reducing P sorption of the soil (Palm *et al.*, 1997). The challenge is to enhance soil fertility with organic sources to optimize nutrient availability to plants. One potential way to decrease negative environmental impacts resulting from inefficient use of chemical fertilizers is inoculation with plant growth promoting rhizobacteria (PGPR). These bacteria exert beneficial effects on plant growth and development and therefore, may be used as biofertilizers for agriculture (Adesemoye *et al.*, 2009). Capabilities of PGPR range from enhancing yields of organic systems to pollution control. A principal problem of organic farming is the low nutrient status of most organic fertilizers (Mengel and Kirkby, 1987). Nutrient content of organic fertilizers varies widely depending on the source and moisture content (Yildrim *et al*., 2001). This problem is further compounded by the difficulties in assessing the value of organic fertilizers through direct analysis of total quantities of plant nutrients. Thus, field experiments are needed to determine the nutrient availability and efficiency of most organic fertilizers. This is the result of the slow and variable release rates of nutrients during decomposition of organic materials (Hsieh and Hsieh, 1990). Biofertilizers with PGPR can be used to increase soil productivity and plant growth in sustainable agriculture through increasing mineral and organic fertilizer use efficiency (Adesemoye *et al.*, 2009). Therefore, a study was conducted to investigate the effects of organic manures and biofertilizer on nutrient content of soil and leaves of litchi air layers.

Materials and Methods

The present investigation was carried out at the Advanced Centre for Horticulture Research, Udheywalla, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu during 2018-19. Different types of potting media such as soil, litchi orchard soil, FYM, sawdust, vermicompost, vermiculite, perlite, neem cake, plant growth promoting rhizobacteria (*Azotobacter*) and cocopeat were used in different combinations after thorough mixing of the ingredients at the experimental farm. The experiment was laid out on randomized block design with twelve treatments and three replications with twenty plants in each replication. The prepared mixtures of the various growing media were field in plastic polybags (30 x 20 x 15 cm^3) and kept in open field conditions. Half of the bags were filled with mixtures before planting and remaining half portion was filled after putting the litchi air-layers cv. Dehradun in middle portion and compress from the side for complete contact with mixtures and water immediately with watering can. Light irrigation was given 3-4 times daily to maintain the proper humidity in open conditions. Observations on nutrient composition of soil as well as of leaves of litchi air layers were recorded for each treatment after six months of transplanting of air layers in potting media. The soilsamples were collected after six months and then air dried.T he leaf samples were collected from 3rd pair of leaflets after six months and then oven dried and grinded. The available nitrogen was determined by Kjeldahl method, available phosphorous by Olsen method (Olsen *et al.*, 1954), available potassium by Flame Photometer method (Table 1).

Results and Discussion

Nutrient content of leaf

Nitrogen content of leaves was found to be significantly higher (1.46 %) in treatment containing litchi orchard soil in combination with rhizobacteria, whereas, the minimum nitrogen content of leaves (1.08 %) was recorded in control. This might be due to that larger root system might have further assisted in efficient moisture and nutrient absorption and hence, higher N and K content in leaf was recorded in growing media comprising litchi orchard soil in combination with rhizobacteria and FYM. Leaf P concentration did not vary significantly due to treatments. However, saplings grown in litchi orchard soil alongwith rhizobacteria and FYM recorded higher leaf P compared to other treatments. He *et al.,* (2003) observed in maize that arbuscular mycorrhiza readily absorbed and translocated ammonium with below ground hyphal network connection with neighbouring root which transfer N from plant to plant. Sharma *et al.,* (2016) reported that plant growth promoting rhizobacteria live in close association with plant roots and have significant potential to improve nutrient use efficiency with plethora of mechanisms with extensive root hyphae for nutrient absorption, release of phytohormone for stimulation of root growth and alteration of plant metabolism for higher nutrient acquisition. Rhizobacteria inoculants increased N and P accumulation in plant tissue in comparison to control plants, suggesting that the mycorrhizal and bacterial plants were using P sources available due to activity of plant growth promoting rhizobacteria (Sharma *et al.,* 2016). The findings are also in agreement with those of Rai *et al.,* (2002) and Kumar *et al.,* (2014) in litchi (Table 2).

Nutrient content of soil

The maximum NPK content of soil was recorded in media containing litchi orchard soil along with rhizobacteria. According to Vejan *et al.,* (2016) sufficient densities of rhizobacteria in biofertilizer provide a beneficial role in creating a proper rhizosphere for plant growth and converting nutritionally important elements through biological process, for example increasing the availability of N, P, K, as well as inhibiting pathogen growth. The high availability of N, P and K could enhance soil fertility, improve antagonistic isolates, bio-control effects and extend microorganisms survival rates in soil. Our findings are supported by Burdman *et al.,* (2000), Dey *et al.,* (2004) in peanut, Lopez *et al.,* (2005) in papaya and Ilyas *et al.,* (2015) in kinnow.

Table.1 Different treatment combinations

Notations	Treatment combinations
M_1	Soil + Sand + FYM (1:1:1)
M_2	Litchi orchard soil + Sand + FYM (1:1:1)
M_3	Litchi orchard soil + Sawdust + FYM (1:1:1)
M_4	Litchi orchard soil + Sawdust + Vermicompost (1:1:1)
M_5	Soil + FYM (1:1) + Plant growth promoting rhizobacteria (PGPR) @50g/kg
M_6	Litchi orchard soil + FYM (1:1) + Plant growth promoting rhizobacteria (PGPR) @50g/kg
M_7	Litchi orchard soil + Neem cake + FYM (1:1:1)
M_8	Litchi orchard soil + Perlite + FYM (1:1:1)
M_9	Litchi orchard soil+ Cocopeat + FYM (1:1:1)
M_{10}	Litchi orchard soil + Vermiculite + FYM (1:1:1)
M_{11}	Litchi orchard soil
M_{12}	Control (soil)

Table.2 Effect of different potting media on nutrient composition of leaves of air layered litchi plants cv.Dehradun

Treatments		Nitrogen (%)	Phosphorous (%)	Potassium (%)
M_1 :	(Soil + Sand + FYM)	1.15	0.14	1.85
M_2 :	(Litchi orchard soil + Sand + FYM)	1.34	0.16	2.05
M_3 :	(Litchi orchard soil + Sawdust + FYM)	1.36	0.14	2.06
M_4 :	(Litchi orchard soil + Sawdust + Vermicompost)	1.35	0.15	2.06
M_5 :	(Soil + Rhizobacteria + FYM)	1.37	0.16	2.16
M_6 :	(Litchi orchard soil + Rhizobacteria + FYM)	1.46	0.24	2.16
M_7 :	(Litchi orchard soil + Neem cake + FYM)	1.35	0.16	2.04
M_8 :	(Litchi orchard soil + Perlite + FYM)	1.36	0.15	2.03
M_9 :	(Litchi orchard soil + Cocopeat + FYM)	1.35	0.16	2.15
M_{10}:	(Litchi orchard soil + Vermiculite + FYM)	1.35	0.15	2.14
M_{11}:	(Litchi orchard soil)	1.35	0.15	2.04
M_{12}:	(Control)	1.08	0.14	1.45
	C.D. $_{(0.05)}$	0.04	N.S.	0.06
	S.E ($\pm$)	0.01	0.00	0.02

Table.3 Effect of different potting media on nutrient composition of soil of air layered litchi plants cv. Dehradun

Treatments		Nitrogen (kg/ha)	Phosphorous (kg/ha)	Potassium (kg/ha)
M_1 :	(Soil + Sand + FYM)	250.06	9.20	103.03
M_2 :	(Litchi orchard soil + Sand + FYM)	262.00	16.25	163.66
M_3 :	(Litchi orchard soil + Sawdust + FYM)	270.86	16.42	163.43
M_4 :	(Litchi orchard soil + Sawdust + Vermicompost)	280.03	17.37	171.58
M_5 :	(Soil + Rhizobacteria + FYM)	291.94	27.03	174.48
M_6 :	(Litchi orchard soil + Rhizobacteria + FYM)	294.76	31.43	177.42
M_7 :	(Litchi orchard soil + Neem cake + FYM)	271.86	16.46	168.52
M_8 :	(Litchi orchard soil + Perlite + FYM)	280.04	18.37	171.51
M_9 :	(Litchi orchard soil + Cocopeat + FYM)	278.99	19.44	171.35
M_{10}:	(Litchi orchard soil + Vermiculite + FYM)	282.96	18.36	173.21
M_{11}:	(Litchi orchard soil)	261.90	16.22	163.13
M_{12}:	(Control)	245.94	8.80	100.39
	C.D. $_{(0.05)}$	8.21	0.84	3.02
	S.E ($\pm$)	2.80	0.29	1.02

In conclusion, efficient plant nutrition management should ensure both enhanced and sustainable agricultural production and safeguard the environment. The present study suggests that the use of plant growth promoting rhizobacteria along with FYM and litchi orchard soil has the potential to increase the soil fertility as well as leaf nutrient composition in litchi plants under organic growing conditions.

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