



ISSN (E): 2277- 7695

ISSN (P): 2349-8242

NAAS Rating: 5.23

TPI 2022; 11(1): 1502-1505

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www.thepharmajournal.com

Received: 14-11-2021

Accepted: 23-12-2021

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Effect of different growing media for elite seedlings production in Arabica coffee (*Coffea arabica* L.)

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DOI: <http://dx.doi.org/10.22271/tpi.2022.v11.i1u.10329>

Abstract

Study on identifying the suitability of different growing media for seedling establishment and elite seedling production in Arabica coffee (*Coffea arabica* L.) cv. Chandragiri was conducted with an objective to evaluate the suitability of different growing media for raising the seedlings and to find out most suitable media for better rooting and growth of coffee seedlings. Coffee seedlings were grown in different media for a period of 6 months in nursery. It was revealed from the study that, the growth and vigour of coffee seedling was greatly influenced by different growing media used. Coffee seedlings grown in growing media containing Soil + Sand + Vermicompost (6:2:1) recorded maximum germination (64%), seedling vigour (2125), seedling height (51.7 cm), number of leaves (8.3), leaf area index (71.17 cm²), diameter of stem (2.18 cm), seedling fresh weight (16.79 g) and higher seedling dry weight (3.09 g) when compared with control and other treatments.

Keywords: Coffee, growing media, germination, seedling vigour, dry weight

Introduction

Coffee (*Coffea* sp.) belongs to family Rubiaceae. Coffee is the second important commodity in international trade. Area under coffee plantation is 397.147 thousand hectares in India and it is producing 3, 97,846 MT of coffee of which Robusta variety accounts for 2, 60,700 MT of production, while Arabica accounted for 1, 08,300 MT. The Karnataka leads in production next top producing states are Kerala and Tamil Nadu. India exports 70-80 per cent of its coffee produce. Commercially coffee is propagated through seeds. There are various factors that influence the initial development of coffee growing in the field, such as the seedlings production process and especially, the container and substrate used (Vallone *et al.*, 2009) [12]. Regarding the substrate, conventionally Forest soil: FYM: Sand (6:2:1). But the availability of forest soil is difficult because of dwindling of forest area and other legal restrictions, so there is a growing demand for the alternate growing media for coffee seedling establishment and elite seedling production. Farmers tend to apply organic amendments that are rich in nutrient, i.e., N, P and K to enhance soil fertility and increase crop productivity (Srigandha *et al.*, 2017) [11].

Materials and Methods

An experiment was conducted during 2020-21 at the Horticulture Research Station, Thadiyankudisai, Tamil Nadu to know the suitable growing media to produce the quality coffee seedlings. The required seeds were collected from Horticulture Research Station, Thadiyankudisai. Coffee berries were collected, immediately after extraction of coffee seeds from berries, the seeds were sown in the following nursery media combination. In nursery media, five gram of each *Azospirillum*, Phosphate Solubilizing Bacteria (PSB) and Vesicular Arbuscular Mycorrhiza (VAM) were additionally added to each treatment. The coffee seeds were sown in three replications by adopting the statistical design of Completely Randomized Design (CRD).

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Treatments	Ratio
T ₀ - Soil + Sand + FYM (Conventional Method)	6:2:1
T ₁ - Soil + Sand + Vermicompost	6:2:1
T ₂ - Soil + Sand + Cocopeat	6:2:1
T ₃ - Soil + Sand + FYM + Vermicompost	5:2:1:1
T ₄ - Soil + Sand + FYM + Cocopeat	5:2:1:1
T ₅ - Soil + Sand + FYM + Vermicompost + Cocopeat	5:1:1:1:1
T ₆ - Soil + Sand + FYM + Vermicompost + Cocopeat	5:2:2:2:2

The plant geometric observations such as germination (ISTA, 2013)^[6] was measured once in 15 days, root length, shoot length, seedling length, number of leaves, diameter of stem, seedling fresh weight, dry weight and seedling vigour (Abdul-Baki and Anderson, 1973)^[2] were measured once in 30 days. The measurement of stem diameter was done at the stem base 2 cm from soil surface by using vernier caliper. The data obtained from experiments were analyzed by the 'F' test for significance by following Completely Randomized Design. Wherever necessary, the percent values were transformed to angular (Arc-sine) values before analysis. The critical differences (CD) were calculated at 5 per cent probability level. The data were tested for statistical significance. (Gomez and Gomez, 1984)^[4].

Results and Discussion

The germination of coffee seedlings was higher in the treatment (T₁) – Soil + Sand + Vermicompost (6:2:1) it recorded 92% germination and vigour index (2125) while the control recorded 74% germination. Azarmi *et al.*, (2008)^[3] stated that high nutrient content particularly nitrogen and phytohormones caused the better vegetative growth. Treatment (T₁) also recorded the higher root and shoot length at 75 DAS and maximum seedling length of 51.7 cm was observed. Weijers *et al.*, (2018)^[13] stated that this hormone could affect cell elongation and stimulated plant height.

Improvement of soil Structure and texture was caused by microbes and vermicompost so that they could increase nutrients absorption by root. Plant height significantly affected number of leaves. Higher plant produced more leaves and photosynthesis well occurred. Number of leaves produced per seedlings was higher in treatment (T₁) it produced 13.5 leaves while control recorded 10.3 leaves and the leaf area was also higher 84.50 cm². The quality of seedling was affected by number of leaves. This process was correlated to the sufficient of nutrients that was easily absorbed and used by plant particularly in leaves formation. Pattnaik and Reddy, (2010)^[10] stated that the vermicompost application increased the number of leaves due to the nutrient content in vermicompost such as N, P, K and Mg. The increasing of leaf area was caused by growth hormone in vermicompost such as auxin, cytokinin and gibberellin could affect the plant growth. Kieber and Schaller, (2018)^[8] stated that cytokinin role was to encourage side part shoots, apical dominance and leaves expansion. Aalok *et al.*, (2008)^[1] also stated that vermicompost contained cytokinin. Endogenous cytokinin content could produce hormone for cell division and formed new shoot that affected total leaf area. The diameter of stem of the seedling was 2.82 cm at 75 DAS in treatment (T₁) it also recorded the higher seedling fresh weight (19.56 g) and dry weight (4.68 g). The result also showed that the increasing of fresh weight is in line to dry weight of arabica coffee seedling. This result indicates that the cell tissue formation increased due to nutrients availability such as N, P and K from vermicompost that required for metabolism process so that the vegetative stage underwent well and supported the increasing of fresh and dry weight of plant. The above results were in conformity with the earlier findings of Pathma and Sakthivel, 2012^[9]; Kashem *et al.*, 2015^[7] and Huang *et al.*, 2019^[5].

Table 1: Influence of different growing media on germination (%), Vigour index and Diameter of stem (cm) for elite seedling production in (*Coffea arabica* L.) cv. Chandragiri

Treatments (T)	Germination (%) 45 DAS	Vigour index 45 DAS	Diameter of stem (cm)			
			45 DAS	60 DAS	75 DAS	Mean
T ₀	74	932	1.03	2.05	2.01	1.70
T ₁	92	2125	1.22	2.51	2.82	2.18
T ₂	72	835	1.01	2.02	2.10	1.71
T ₃	81	1466	1.04	2.12	2.12	1.76
T ₄	77	1447	1.03	2.09	2.05	1.72
T ₅	85	1241	1.11	2.21	2.55	1.96
T ₆	89	1780	1.15	2.39	2.78	2.11
Mean	81.43	1403	1.08	2.20	2.35	1.88
SEd	1.983	28.65	0.025	0.046	0.051	0.041
CD (P = 0.05)	4.349	61.47	0.053	0.099	0.111	0.089

Treatments details

T ₀ – Soil + Sand + FYM (Conventional Method) (6:2:1)	T ₁ – Soil + Sand + Vermicompost (6:2:1)	T ₂ – Soil + Sand + Cocopeat (6:2:1)
T ₃ – Soil + Sand + FYM + Vermicompost (5:2:1:1)	T ₄ – Soil + Sand + FYM + Cocopeat (5:2:1:1)	T ₅ – Soil + Sand + FYM + Vermicompost + Cocopeat (5:1:1:1:1)
T ₆ – Soil + Sand + FYM + Vermicompost + Cocopeat (5:2:2:2:2)		

Table 2: Influence of different growing media on Seedling height (cm) for elite seedling production in (*Coffea arabica* L.) cv. Chandragiri

Treatments (T)	45 DAS		Seedling height (cm)	60 DAS		Seedling height (cm)	75 DAS		Seedling height (cm)
	Shoot Length (cm)	Root Length (cm)		Shoot Length (cm)	Root Length (cm)		Shoot Length (cm)	Root Length (cm)	
T ₀	9.1	3.5	12.6	11.5	4.6	16.1	12.5	5.4	17.9
T ₁	14.6	8.5	23.1	22.5	16.8	39.3	28.9	22.8	51.7

T ₂	8.5	3.1	11.6	9.3	4.6	13.9	10.5	5.6	16.1
T ₃	11.7	6.4	18.1	13.5	7.2	20.7	14.6	8.1	22.7
T ₄	12.9	5.9	18.8	11.5	6.2	17.7	13.5	7.6	21.1
T ₅	9.5	5.1	14.6	12.6	6.2	18.8	15.5	7.3	22.8
T ₆	13.6	6.4	20.0	17.1	9.3	26.4	24.6	15.1	39.7
Mean	11.4	5.6	17.0	14.0	7.8	21.8	17.2	10.3	27.4
S.Ed	0.236	0.112	0.231	0.200	0.191	0.326	0.431	0.322	0.825
CD (P = 0.05)	0.506	0.2410	0.496	0.430	0.410	0.701	0.926	0.692	1.771

Table 3: Influence of different growing media on Number of leaves and Leaf area (cm²) for elite seedling production in (*Coffea arabica* L.) cv. Chandragiri

Treatments (T)	Number of leaves				Leaf area (cm ²)			
	45 DAS	60 DAS	75 DAS	Mean	45 DAS	60 DAS	75 DAS	Mean
T ₀	2.2	5.2	10.3	5.9	41.50	58.60	71.20	57.10
T ₁	4.2	7.2	13.5	8.3	56.50	72.50	84.50	71.17
T ₂	2.4	5.6	8.4	5.5	40.20	57.60	70.10	55.97
T ₃	3.2	6.1	10.4	6.6	47.50	62.80	75.90	62.07
T ₄	3.2	6.1	10.2	6.5	43.60	60.10	72.30	58.67
T ₅	3.5	6.3	11.2	7.0	49.50	66.60	80.10	65.40
T ₆	3.4	6.5	12.7	7.5	51.40	67.90	81.40	66.90
Mean	3.2	6.1	11.0	6.8	47.17	63.73	76.50	62.47
S.Ed	0.052	0.127	0.285	0.149	0.937	1.039	1.504	1.370
CD (P = 0.05)	0.113	0.273	0.611	0.321	2.009	2.230	3.227	2.940

Table 4: Influence of different growing media on Seedling fresh weight (g) and Seedling dry weight (g) for elite seedling production in (*Coffea arabica* L.) cv. Chandragiri

Treatments (T)	Seedling fresh weight (g)				Seedling dry weight (g)			
	45 DAS	60 DAS	75 DAS	Mean	45 DAS	60 DAS	75 DAS	Mean
T ₀	9.05	9.25	13.68	10.66	1.05	1.18	2.12	1.45
T ₁	13.54	17.26	19.56	16.79	1.64	2.95	4.68	3.09
T ₂	9.02	9.16	12.28	10.15	1.02	1.25	2.41	1.56
T ₃	9.86	10.56	14.84	11.75	1.55	1.73	2.05	1.78
T ₄	9.12	9.39	14.02	10.84	1.22	1.67	2.01	1.63
T ₅	10.92	13.58	16.54	13.68	1.24	2.12	3.11	2.16
T ₆	11.02	14.11	17.12	14.08	1.03	2.86	3.01	2.30
Mean	10.36	11.90	15.43	12.56	1.25	1.97	2.77	2.00
S.Ed	0.239	0.032	0.053	0.048	0.027	0.039	0.045	0.054
CD (P = 0.05)	0.514	0.069	0.114	0.103	0.058	0.084	0.097	0.117

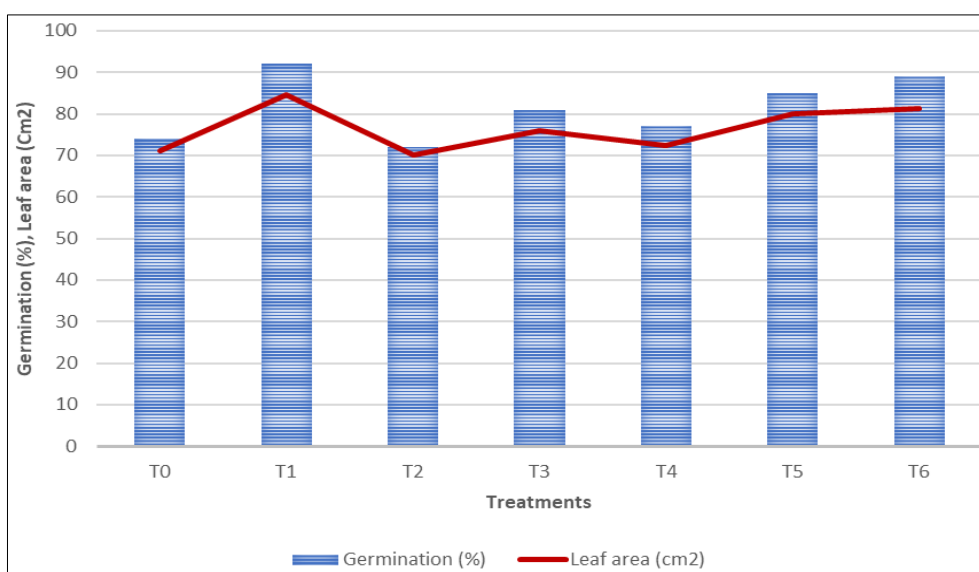


Fig 1: Influence of different growing media on germination (%) and Leaf area (cm²) for elite seedling production in (*Coffea arabica* L.) cv. Chandragiri

Conclusion

The present research findings indicate that growth and vigour of coffee seedling was greatly influenced by different growing media used. Coffee seedlings grown in growing media

containing Soil + Sand + Vermicompost (6:2:1) recorded maximum germination, seedling vigour, seedling height, number of leaves, leaf area index, diameter of stem, seedling fresh weight and higher seedling dry weight when compared

with control and other treatments. Thus it could be concluded that the growing media containing Soil + Sand + Vermicompost (6:2:1) is best suited for the elite seedling production.

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