International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(4): 319-321

Received: 22-05-2019
Accepted: 24-06-2019

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Effect of growing media on tomato seedling production

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Abstract
Experiments were laid out with ten treatments in a completely randomized design (CRD) with three replications for standardizing the growing media for seedling production in containers for tomato cv. PKM 1. The treatments included different growing media such as, red soil, sand, cocopeat, vermicompost and farm yard manure in different ratios based on volume. Results revealed that, among the treatments, T9 (75% vermicompost + 25% cocopeat) recorded the highest germination percentage (93.54 %) and lowest days taken for germination (4.00 days). The seedling growth parameters like seedling height (19.80 cm), seedling girth(1.00 cm), leaf area (9.00 cm^2), leaf chlorophyll content (28.77), shoot length (14.13 cm), root length (5.68 cm), seedling fresh weight(1.454 g), root to shoot ratio (0.373) and vigour index (1790.2) were significantly higher in the treatment T10 (75% Vermicompost + 25% FYM) than control. Mortality was also minimum (11.49 %) in the treatment T10. The B: C ratio was highest (2.78) in the treatment T_2.

Keywords: Growing media, tomato seedling production

Introduction
Tomato (*Solanum lycopersicum* L.), member of Solanaceous family is one of the most important vegetable crop famous for its nutritive and medicinal value (Opeña and Kyomo, 1990) [8]. Tomato universally treated as 'Protective Food', is being extensively grown as annual plant. It is being grown worldwide in China, India, USA, Turkey, Italy, Egypt and Spain as a popular vegetable. The production of healthy and vigorous seedling is the most important factor in successful production and yield of tomato fruits. Germination of the seed is a critical stage, because, the rest of the plant life is directly depending upon the rate of its germination.

Growing medium directly affects seed germination, seedling growth and development. A good growth medium provides sufficient anchorage or support to the plant, serves as a reservoir for nutrients and water. The quality of seedlings obtained from a nursery influences re-establishment in the field and the eventual productivity of an orchard. Hence, attention has to be given from nursery stage itself in order to improve the seedling vigour. Effective growing media for tomato seedling should be physically very stable, should not interfere with plant nutrition, light in weight for easy transport and can minimize the soil borne diseases.

Red soil is generally used as a basic medium, because, it is inexpensive and easy to acquire. Supplementing sand is aimed at making the medium more porous. While organic matter (Farm Yard Manure and Vermicompost) is added to enrich seedlings with adequate nutrients, cocopeat is considered as a good growth media component with acceptable pH, electrical conductivity and other chemical attributes (Abad *et al*, 2002) [1]. Cocopeat has good physical properties, high total pore space, high water content, low shrinkage, low bulk density and is slow to biodegrade.

Literatures are scarcity for the study on seedling performance in protrays under different growing media. Hence, this study was undertaken to evaluate the effect of different growing media on seed germination and production of healthy tomato seedlings.

Materials and methods
The experiment was conducted at the nursery, University Orchard, Department of Vegetable Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore during 2017-2018.

The experiment was laid out in completely randomized design (CRD) with three replications. Media with ten different combinations were prepared on volume basis and filled in protrays. The treatment details are given below.

The treatment details are given below.

T_1	Soil + Sand + FYM (1:1:1) – Control
T_2	50 % Cocopeat + 50% FYM
T_3	50% Cocopeat + 50% Vermicompost
T_4	75% Cocopeat + 25% FYM
T_5	75% Cocopeat + 25% Vermicompost
T_6	50% FYM + 50% Vermicompost
T_7	75% FYM + 25% Cocopeat
T_8	75% FYM + 25% Vermicompost
T_9	75% Vermicompost + 25% Cocopeat
T_{10}	75% Vermicompost + 25% FYM.

The protrays were filled according to the different media composition as mentioned above. To all the treatments, neemcake and biofertilizers were added equally to enrich the nutrient content of media component. Seeds were sown at the rate of one seed per cell. After sowing the seeds of tomato cv. PKM 1, the protrays were irrigated and placed one above the other and covered with polythene sheet for effective germination. After germination, the protrays were placed on the raised beds for proper drainage inside the 50 % shade net. The protrays were irrigated regularly. Water soluble 19:19:19 fertilizers were drenched @ 5g/l on 18 days after sowing to boost the growth.

Different seedling attributes namely days taken for germination, germination (%), seedling height, seedling girth (cm), leaf area (cm^2), shoot length (cm), root length (cm), seedling fresh weight (g), root to shoot ratio, vigour index and mortality (%) were recorded at the transplanting age. The chlorophyll level of the leaves was measured using a chlorophyll meter (SPAD; Minolta, Tokyo, Japan). The results were presented as SPAD readings. The vigour index was calculated by multiplying the germination percentage with seedling height. B: C ratio was calculated and presented.

Results and discussions

Germination percentage

The statistical analysis of the data revealed the following findings. Among the treatments, lowest number of days taken for germination (4.00 days) and highest germination percent (93.54 %) were observed in T_9 (75% Vermicompost + 25% Cocopeat). Lowest germination percent (84.73 %) and more number of days taken for germination (6.17 days) were found in T_1 (Red soil+ Sand + FYM) which served as control. Attainment of maximum percentage of germination in vermicompost medium indicates that, presence of humic acid and growth promoting hormones in vermicompost might have helped for early germination. The observations are similar with the findings of other researchers *viz*., Sujatha *et al.* (2003) [11] and Owa *et al.* (2008) [9].

Seedling growth parameters

The data observed for seedling height, seedling girth and leaf area presented in table 1. It indicated that seedling height (19.80 cm), seedling girth (1.0 cm) and leaf area (9.00 cm^2), were highest in T_{10} (75% Vermicompost + 25% FYM). The improvement in seedling height, seedling girth and leaf area due to the application of vermicompost might be due to the presence of humic acid which enhanced the soil physical condition and utilization of plant nutrients in tomato (Atiyeh *et al.*, 2000) [2].

Shoot and root length

The data observed that on shoot length, root length, fresh weight and root to shoot ratio showed that there were significantly affected by the growing media for tomato seedlings. Maximum shoot length (14.13 cm), root length (5.68 cm), seedling fresh weight (1.454 g) and root to shoot ratio (0.373) were recorded in T_{10} (75% vermicompost + 25% FYM). The lowest was noticed in T_1 (control). The superiority of vermicompost could be due to its better physical structure that utilized the space, moisture and nutrients properly and encouraged vigorous and healthy seedling growth (Alex *et al*., 2007). Another possible reason was the presence of bioactive principles in vermicompost is considered to be beneficial for root growth, root initiation, germination and growth of the plant (Bachman *et al.*, 2008) [3], and also having a balanced composition of nutrients (Zaller, 2007) [12].

Vigour index and mortality

Among the treatments, highest vigour index (1790.2) and the lowest mortality percentage (11.49 %) was observed in T_{10} (75% Vermicompost + 25% FYM). The highest morality percentage was recorded in T_1 (control) with 18.43%. Since heavy soil has poor drainage, the development of roots were suppressed and the plants might be more susceptible to soil borne diseases (Beattie and Garrett, 1995) [4]. Organic amendments reduced the damping off disease in seedling stage besides producing quality seedlings and this might be the reason for getting quality seedlings with less mortality in this treatment and this was supported by Shiau *et al.* (1999) [10] in cabbage. The data observed for leaf chlorophyll (28.77) was highest in T_{10} (75% Vermicompost + 25% FYM). This might be attributed to more uptake of nitrogen by the plants in the vermicompost applied trays and this was supported by Nagaraj *et al.* (2015) [7] in bell pepper.

Cost benefit ratio

In tomato T_4 (75% Cocopeat + 25 % FYM) registered highest B: C ratio of 2.78. The lowest was observed in T_1 (control) with a value of 1.66. When compared to cocopeat and FYM, the cost of vermicompost in very high thus reduces the B: C ratio in the vermicompost applied protrays (T_3, T_5, T_6, T_8, T_9 and T_{10}). The rest of the treatments containing other media (T_2 and T_7) registered higher B: C ratio than the vermicompost applied protrays. Increased B: C ratio obtained by the addition of organic amendments was observed by the earlier workers Chatterjee *et al*. (2013) [5] and Mal and Chatterjee (2016) [6] in cabbage seedlings.

Table 2: Effect of growing media on days taken for germination, germination percentage, seedling height, seedling girth, leaf area and leaf chlorophyll of tomato cv. PKM 1 seedlings.

Treatments	Days taken for germination	Germination percentage (%)	Seedling height (cm)	Seedling girth (cm)	Leaf area (cm^2)	Leaf chlorophyll (SPAD readings)
T_1	6.17	84.73	13.21	0.6	3.31	21.37
T_2	4.02	92.16	17.11	0.9	3.49	27.48
T_3	4.50	89.29	15.58	0.7	3.51	26.91
T_4	5.50	89.12	15.59	0.7	4.52	25.39
T_5	5.00	89.46	15.70	0.9	5.23	25.87
T_6	6.00	85.84	16.94	0.8	7.02	26.35
T_7	4.05	87.24	18.48	1.0	8.39	26.32
T_8	5.50	88.27	17.23	0.9	7.69	27.23
T_9	4.00	93.54	18.07	0.9	8.92	26.97
T_{10}	4.50	90.31	19.80	1.0	9.00	28.77
S. Ed.	0.17	1.88	0.89	0.07	0.28	1.20
CD(P=0.05)	0.35*	3.77*	1.78*	0.14*	0.55*	2.41*

Table 3: Effect of growing media on shoot length, root length, seedling dry weight, root to shoot ratio, vigour index, mortality percentage and B: C ratio of tomato cv. PKM 1 seedlings.

Treatments	Shoot length (cm)	Root length (cm)	Seedling fresh weight (g)	Root to shoot ratio	Vigour index	Mortality (%)	Average B: C ratio
T_1	10.25	2.58	0.963	0.274	1126.7	18.43	1.66
T_2	12.33	4.79	1.158	0.314	1568.1	12.44	2.74
T_3	10.87	4.71	1.118	0.337	1400.1	14.64	2.05
T_4	10.68	4.91	1.264	0.368	1391.7	15.68	2.78
T_5	10.63	5.45	0.965	0.280	1418.3	17.37	2.28
T_6	11.94	5.00	1.103	0.346	1416.2	17.06	1.84
T_7	13.68	4.80	1.310	0.371	1619.1	16.35	2.52
T_8	12.75	4.48	1.226	0.313	1528.2	14.70	2.09
T_9	12.61	5.46	1.236	0.354	1694.3	16.63	1.84
T_{10}	14.13	5.68	1.454	0.373	1790.2	11.49	1.81
S. Ed.	0.72	0.59	0.037	0.018	81.61	1.89	-
CD(P=0.05)	1.46*	1.18*	0.073*	0.037*	164.01*	3.80*	-

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