Studies on Standardization of Growing Media and Growing Conditions for Nursery Production of Tomato

Abstract

The aim of the investigation was to standardize growing media and environmental conditions for optimal nursery production of tomato (*Solanum lycopersicum* L.). The study was conducted at the Centre of Excellence, Mulugu, during 2024-2025 using a Factorial Randomized Block Design at the nursery stage. Treatments included five growing media i.e., cocopeat (100%), cocopeat + vermicompost (1:1), cocopeat + vermiculite + perlite (2:1:1), cocopeat + biochar (1:1) and cocopeat + biochar (2:1) combined with three environments: open field, polyhouse and shade net house. Methodology involved fifteen treatment combinations, each replicated thrice, with data collected on germination parameters and seedling growth metrics from five randomly selected plants per replication. Results showed that the highest germination percentage (100%) was consistently observed under polyhouse conditions across all media, with the quickest germination in cocopeat + vermicompost (1:1) under polyhouse (7.00 days). Seedling growth parameters including stem diameter (1.96 mm in cocopeat + biochar (1:1) under shade net), leaf number (5.67 in cocopeat + vermicompost (1:1) under polyhouse), shoot length (6.27 cm), root length (10.15 cm), leaf area (11.09 cm^2) and seedling vigour index (1741.07) were highest in cocopeat + vermicompost (1:1) under polyhouse. The study concludes that a combination of cocopeat + vermicompost (1:1) as growing media under polyhouse conditions significantly enhances germination parameters and seedling growth in tomato, supporting its use for robust nursery production.

Keywords: *Tomato, nursery production, growing media, germination, seedling growth*

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is a high-value vegetable crop that is widely consumed fresh or processed and grown in almost every country of the world. It is originated from the Andean zone (Peru-Ecuador-Bolivian area) but it's first cultivation was in Mexico. The chromosome number of a tomato is typically 2n = 24. The tomato is an annual plant, in the Solanaceae family, typically growing to 1000 -3000 mm tall, with a weakly woody stem that usually scrambles over other plants. The fruit is edible; brightly coloured (usually red, from the pigment lycopene) its diameter ranges between 10-20 mm in wild plants and cultivated forms. Botanically, it is a berry, with a subset of fruits. In India, area under tomato reported during 2023-24 was 8.50 lakh ha. (Anonymous a, 2024). Production of Tomato is expected to be around 212.38 Lakh Tonne in 2023-24 (Second Advance Estimates) compared to around

204.25 Lakh Tonne last year, an increase by 3.98% Lakh Tonne. (Anonymous b, 2023). Major producing states are Madhya Pradesh, Andhra Pradesh, Karnataka, Odisha, Gujarat, West Bengal and Tamil Nadu. It contains high levels of bioactive compounds such as carotenoids, fibre, protein and pectin. These bioactive compounds are known as good protective constituents against several human diseases. Tomato is processed into many products such as ketchup, paste, sauce, puree, soup, juice and canned tomatoes. (Kiralan and Ketenoglu, 2022)

The production of healthy and vigorous seedlings is crucial to achieving high yields and quality in tomato. Nursery practices such as the selection of appropriate growing media and the control of growing conditions play a pivotal role in determining the success of transplant production. Traditional nursery methods often face challenges like low productivity, inconsistent seedling quality and adverse environmental impacts. Hence, the development of optimized and standardized growing conditions is essential for sustainable and high-quality vegetable production.

Studies have shown that the growing medium is a key determinant of seed germination, seedling vigour and the overall success of transplant production. Various types of media, such as coir pith, vermicompost, cocopeat and commercial growing mixes, have been studied extensively for their effects on seedling growth parameters. For instance, Periasamy and Duraisamy demonstrated that coir pith, either alone or in combination with vermicompost, significantly improved tomato seedling growth with superior shoot length, root length and germination rates compared to other media (Vivek and Duraisamy, 2017). Similarly, studies by Mathowa *et al*. (2016) highlighted the importance of commercial growing media such as hygromix in promoting the emergence and growth of tomato seedlings under controlled environmental conditions. These findings underscore the importance of media selection in optimizing nursery production.

Given the growing interest in organic and sustainable nursery practices, there is a need to standardize growing media and nursery conditions for tomato production. This research aims to evaluate the effects of different growing media and environmental conditions on the growth and development of this crop, with the goal of developing standardized practices that can be easily adopted by farmers.

MATERIALS AND METHODS

The current study “Studies on standardization of growing media and growing conditions for nursery production of tomato” was conducted at Centre of Excellence, Mulugu,

Siddipet district, Telangana in the year 2024-2025. The experimental site is located at a latitude of $17^0$43'02" N and a longitude of $78^0$37'34" E in Central Telangana Agroclimatic Zone. The experiment was conducted using a Factorial Randomized Block Design (FRBD) with two factors: **Factor 1** – Growing Media (Cocopeat (100%, Cocopeat + Vermicompost (1:1), Cocopeat + Vermiculite + Perlite (2:1:1), Cocopeat + Biochar (1:1), Cocopeat + Biochar (2:1) and **Factor 2** – Growing Environment (Open field, Polyhouse and Shade net house). The observations were recorded on germination parameters like germination percentage (%) and number of days taken for seed germination and seedling growth parameters viz., stem diameter (mm), number of leaves, shoot length (cm), root length (cm), root-to-shoot ratio, leaf area (cm^2), days taken to reach transplanting stage, seedling vigour index using five (5) randomly tagged seedlings from each replication throughout the study. After 7 days – 14 days of sowing the germination parameters were recorded for all three crops. At 15 and 25 days after sowing interval stem diameter, number of leaves and shoot length has been recorded and root length, root-to-shoot ratio, leaf area, days taken to reach transplanting stage, seedling vigour index are recorded at transplanting stage. The data was statistically analysed as per the procedure of Panse and Sukhatme (1985). SEm and CD at 5% level were calculated to test significance.

RESULTS AND DISCUSSION

Germination Percentage

The experiment results revealed that among the growing media, the highest germination percentage in tomato was recorded in Cocopeat + Vermiculite + Perlite (2:1:1) with 91.27%, while the lowest was in Cocopeat + Biochar (1:1) at 78.18%. The polyhouse environment showed the highest germination at 100%, whereas the open field had the lowest at 57.14%. Interaction effects highlighted 100% germination in several treatments under polyhouse, contrasting with the lowest 34.53% in Cocopeat + Biochar (1:1) under open field conditions. Similar findings were observed by Raja *et al*., 2018, Haska *et al*., 2022.

Number of days taken for seed germination

Results indicated that the number of days taken for tomato seed germination showed minor variation among growing media, with biochar-based media slightly delaying germination but no significant differences overall. The growing environment had a prominent effect, with the shortest germination period of 7 days observed in both the polyhouse and shade net house, while the open field recorded the longest duration of 11.60 days. Interaction effects were not statistically significant, though trends showed quicker germination in protected

environments across all media compared to slower emergence in open field conditions. Our findings are in agreement with that obtained by Melo *et al*., 2019.

Stem diameter (mm)

Results demonstrated that the highest stem diameter at 25 days after sowing (DAS) in tomato was recorded in Cocopeat + Vermicompost (1:1) with 1.56 mm, while the lowest was observed in Cocopeat + Vermiculite + Perlite (2:1:1) at 1.42 mm. Among environments, the shade net house produced the maximum stem diameter of 1.92 mm, whereas the open field had the minimum of 0.61 mm. The interaction effect revealed the greatest stem thickness of 1.96 mm in Cocopeat + Biochar (1:1) under shade net house and the lowest at 0.50 mm in Cocopeat + Vermiculite + Perlite (2:1:1) in the open field. Our results are in agreement with Awad (2010), Boxi and Jana (2024), Haska *et al*., 2022.

Number of leaves

At 25 days after sowing (DAS), the highest number of leaves in tomato seedlings was recorded in both Cocopeat + Vermicompost (1:1) and Cocopeat + Vermiculite + Perlite (2:1:1) media with 5.07 leaves, while the lowest was found in Cocopeat (100%) and Cocopeat + Biochar (2:1) media with 4.67 leaves. Among growing environments, the polyhouse produced the maximum leaf number of 5.48 and the open field had the lowest with 4.13 leaves. The interaction effect showed the highest leaf count of 5.67 in Cocopeat + Vermicompost under polyhouse, whereas the lowest number of 3.93 leaves occurred in Cocopeat + Biochar under open field conditions. This observation aligns with the work of Hernandez-Rodriguez *et al*., 2017, Haska *et al*., 2022.

Shoot length (cm)

At 25 days after sowing (DAS), the highest shoot length in tomato seedlings was recorded in the Cocopeat + Vermicompost (1:1) media with 5.33 cm, while the lowest was observed in the Cocopeat + Vermiculite + Perlite (2:1:1) media at 3.45 cm. Among the growing environments, the shade net house produced the maximum shoot length of 4.50 cm, whereas the open field had the minimum at 2.63 cm. The interaction effect revealed the longest shoot length of 6.27 cm in Cocopeat + Vermicompost under the shade net house and the shortest at 2.07 cm in Cocopeat + Biochar (2:1) under open field conditions. These findings are in agreement with the findings of Alam *et al*., 2014, Atif *et al*., 2016.

Root length (cm)

In tomato seedlings at the transplanting stage, the greatest root length was observed in the Cocopeat + Vermicompost (1:1) medium, measuring 9.84 cm, whereas the shortest root length of 6.58 cm was found in the Cocopeat + Biochar (1:1) medium. Among the growing environments, the polyhouse achieved the maximum root length of 8.20 cm, closely followed by the shade net house at 8.16 cm, with the open field showing the minimum root length of 6.67 cm. The interaction effect highlighted the highest root length of 10.15 cm in Cocopeat + Vermicompost under polyhouse conditions, while the lowest of 4.41 cm was recorded in Cocopeat + Biochar under open field conditions. This observation aligns with the work of Ghimire *et al*., 2024, Faruq and Islam (2007), Unal (2013).

Root-to-shoot ratio

The highest root-to-shoot ratio at the transplanting stage in tomato was recorded in the 100% Cocopeat medium at 0.41, while the lowest ratio of 0.27 was found in the Cocopeat + Biochar (2:1) medium. Regarding growing environments, the polyhouse condition exhibited the highest ratio at 0.37, with the shade net house showing the lowest at 0.29. The interaction effects showed the greatest root-to-shoot ratio of 0.47 in Cocopeat + Biochar under polyhouse conditions, whereas the smallest ratio of 0.23 occurred with the same media under the shade net house. This observation aligns with the work of Ghimire *et al*., 2024.

Leaf area (cm^2)

In tomato seedlings at the transplanting stage, the greatest leaf area was recorded in the Cocopeat + Vermicompost medium with 7.10 cm^2, whereas the smallest leaf area of 2.03 cm^2 was observed in the Cocopeat + Biochar medium. Considering different growing conditions, the polyhouse environment exhibited the maximum leaf area of 4.74 cm^2, while the open field had the lowest at 2.43 cm^2. The interaction effect demonstrated the largest leaf area of 11.09 cm^2 in Cocopeat + Vermicompost under polyhouse conditions, with the smallest of 1.06 cm^2 occurring in Cocopeat + Vermiculite + Perlite under open field conditions. The present study echoes the findings of Paul and Metzger (2005).

Days taken to reach transplanting stage

At the transplanting stage, the shortest duration to reach transplanting in tomato was recorded with the Cocopeat + Vermicompost (1:1) media at 30.00 days, while the longest duration was observed in the Cocopeat + Biochar (2:1) media at 33.33 days. Among growing

environments, the polyhouse condition showed the shortest time of 30.00 days and the open field had the longest duration of 34.00 days. The interaction revealed the earliest transplanting of 30.00 days in combinations like Cocopeat + Vermicompost under polyhouse and the maximum duration of 35.00 days in Cocopeat + Biochar under open field.

Seedling vigour index

The seedling vigour index for tomato was highest in the Cocopeat + Vermicompost (1:1) medium with a value of 1367.72, while the lowest value of 878.66 was found in the Cocopeat + Biochar (1:1) medium. Under different growing conditions, the Shade net house (E_3) exhibited the maximum vigour index at 1399.00, whereas the Open field (E_1) showed the lowest value of 413.17. The interaction effect revealed the highest seedling vigour index of 1741.07 in Cocopeat + Vermicompost grown under Shade net house, while the lowest of 153.30 occurred in Cocopeat + Biochar under Open field conditions. This is reinforced by the work of Atif *et al*., 2016, Ghimire *et al*., 2024.

Table 1: Effect of growing media and growing environments and their interaction on germination percentage (%) and number of days taken for seed germination of tomato

Treatments	Germination Percentage (%)	Number of days taken for seed germination
Growing media		
G_1	86.51	8.33
G_2	88.49	8.67
G_3	91.27	8.22
G_4	78.18	8.89
G_5	82.54	8.56
S.Em ±	0.51	0.21
CD @ 5%	1.48	NS
Growing environment		
E_1	57.14	11.60
E_2	100.00	7.00
E_3	99.05	7.00
S.Em ±	0.40	0.16
CD @ 5%	1.15	0.46
Interaction		
G_1E_1	61.90	11.00
G_1E_2	100.00	7.00
G_1E_3	97.62	7.00
G_2E_1	66.66	12.00
G_2E_2	100.00	7.00
G_2E_3	98.81	7.00
G_3E_1	73.81	10.67
G_3E_2	100.00	7.00

G_3E_3	100.00	7.00
G_4E_1	34.53	12.67
G_4E_2	100.00	7.00
G_4E_3	100.00	7.00
G_5E_1	48.81	11.67
G_5E_2	100.00	7.00
G_5E_3	98.81	7.00
S.Em ±	0.89	0.36
CD @ 5%	2.56	NS

Table 2: Effect of growing media and growing environments and their interaction on seedling growth parameters of tomato

Treatments	Stem diameter (mm)	Number of leaves	Shoot length (cm)	Root length (cm)	Root-to-shoot ratio	Leaf area (cm^2)	Days taken to reach transplanting stage	Seedling vigour index
Growing media								
G_1	1.43	4.67	3.49	8.21	0.41	2.58	32.33	986.36
G_2	1.56	5.07	5.33	9.84	0.29	7.10	30.00	1367.72
G_3	1.42	5.07	3.45	6.94	0.35	2.26	32.67	1001.68
G_4	1.46	4.73	3.46	6.58	0.35	2.03	32.67	878.66
G_5	1.44	4.67	3.51	6.81	0.27	2.59	33.33	913.83
S.Em ±	0.01	0.05	0.03	0.05	0.01	0.01	0.21	26.61
CD @ 5%	0.02	0.15	0.09	0.15	0.02	0.04	0.62	77.09
Growing environment								
E_1	0.61	4.13	2.63	6.67	0.34	2.43	34.00	413.17
E_2	1.85	5.48	4.41	8.20	0.37	4.74	30.00	1276.21
E_3	1.92	4.91	4.50	8.16	0.29	2.77	32.60	1399.58
S.Em ±	0.01	0.04	0.02	0.04	0.01	0.01	0.17	20.61
CD @ 5%	0.02	0.12	0.07	0.12	0.02	0.03	0.48	59.72
Interaction								
G_1E_1	0.65	4.20	2.51	8.30	0.46	2.36	35.00	514.97
G_1E_2	1.81	5.53	4.08	8.00	0.38	2.86	30.00	1176.00
G_1E_3	1.83	4.27	3.89	8.33	0.39	2.51	32.00	1268.13
G_2E_1	0.85	4.27	4.23	10.03	0.26	5.46	30.00	885.10
G_2E_2	1.88	5.67	5.50	10.15	0.28	11.09	30.00	1477.00
G_2E_3	1.95	5.27	6.27	9.33	0.32	4.77	30.00	1741.07
G_3E_1	0.50	4.27	2.21	5.70	0.39	1.06	35.00	327.03
G_3E_2	1.81	5.60	4.03	7.60	0.39	3.76	30.00	1358.00
G_3E_3	1.94	5.33	4.10	7.53	0.26	1.95	33.00	1320.02
G_4E_1	0.55	4.00	2.13	4.41	0.32	1.29	35.00	153.30
G_4E_2	1.87	5.40	4.15	7.17	0.47	2.74	30.00	1150.00
G_4E_3	1.96	4.80	4.09	8.17	0.26	2.05	33.00	1332.67
G_5E_1	0.50	3.93	2.07	4.90	0.26	1.98	35.00	185.47
G_5E_2	1.90	5.20	4.31	8.10	0.31	3.23	30.00	1220.03
G_5E_3	1.91	4.87	4.15	7.43	0.23	2.55	35.00	1336.00
S.Em ±	0.01	0.09	0.05	0.09	0.01	0.02	0.37	46.09
CD @ 5%	0.04	0.27	0.15	0.26	0.04	0.07	1.08	133.53

CONCLUSION

The study clearly demonstrates that the combination of cocopeat and vermicompost (1:1) used as growing media under polyhouse conditions is the most effective approach for robust

tomato nursery production, significantly enhancing germination rates and seedling growth parameters across the tested environments and treatments. The cocopeat + vermicompost (1:1) mix under polyhouse conditions led to the highest and fastest germination, with strong advantages in stem diameter, leaf count, shoot length, root length, leaf area, seedling vigour, and speed to transplant stage compared to all other combinations. Polyhouse environments consistently outperformed open field and shade net conditions for all major growth parameters, demonstrating the value of protected cultivation techniques for nursery production. These findings reinforce the importance of both media composition and the choice of growing environment in nursery management of tomato.

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