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IDENTIFICATION OF SUITABLE GROWTH MEDIA FOR TOMATO (*Solanum lycopersicum* L.) CULTIVATION IN PROTECTED AGRICULTURE

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A study was investigated to identify the most suitable growth media for growing '*Bathiya*' tomato variety under polytunnel conditions. Six different media combinations: Sand + soil + coir dust (T1), Sand + PBRH + soil (T2), Sand + PBRH + soil + coir dust (T3), Sand + PBRH + soil + coir dust + compost (T4), Sand only (T5- Control), Coir dust only (T6) were evaluated in a pot experiment using completely randomized design with four replicates. Data on key growth parameters such as plant height, number of leaves per plant, and number of branches per plant were measured biweekly while root length, shoot length, fresh shoot weight, and fresh root weight were recorded at harvest. The number of fruits per plant and total yield were recorded as yield parameters. Results revealed that there was no significant difference among T4, T3, and T2 in plant height ($p < 0.0047$) and the number of branches ($p < 0.0005$). T6 exhibited significantly lowest plant height of 79.1cm while significantly fewer branches of 14.2 and 3.5 were recorded in T5 and T6 respectively. In shoot length, except T6 (64.0 cm), all other treatments were not significantly different. Significantly higher fresh shoot and root weights were recorded in T3, T4, and T2. Conversely, T6 consistently produced the lowest values across all growth parameters. T4 exhibited the highest fruit production per plant (51.5) followed by T2 (39.5) and T3 (30.5) whereas, significantly lower fruit numbers were recorded in T6 ($p < 0.001$). When considering the total yield, except T6 (10.2 kg/plant), all other treatments were in a homogeneous group ($p < 0.036$). Treatment T4 followed by T3 and T2 showed promising growth and yield performances in this study. In contrast, single-component media sand and coir dust alone were performed poorly. Results suggest that incorporating organic components together with aeration-enhancing materials enhances growth and yield of tomato under protected environments.

Keywords: compost, PBRH, polytunnel, productivity, yield

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INTRODUCTION

Tomato (*Solanum lycopersicum* L.), a globally cultivated crop from the Solanaceae family, faces challenges from climate variability that affect yield and quality. Protected environments offer a solution by enabling year-round production and improved resource use. Success in such systems depends on selecting suitable growth media. This study evaluates combinations of sand, soil, coir dust, partially burnt rice husk, and compost for cultivating the tomato variety '*Bathiya*' under protected conditions, with the aim of enhancing yield, quality, and sustainability in local protected agriculture.

METHODOLOGY

The effectiveness of different growth media combinations was evaluated under polytunnel conditions at the Horticultural Crops Research and Development Institute, Gannoruwa, from June to December 2024. The experiment was conducted using a completely randomized design (CRD) with four replicates. Six treatments tested were: T1 – sand + soil + coir dust (1:2:1); T2 – sand + partially burnt rice husk (PBRH) + soil (1:1:2); T3 – sand + PBRH + soil + coir dust (1:1:2:1); T4 – sand + PBRH + soil + coir dust + compost (1:1:2:1:1); T5 – sand only (control); and T6 – coir dust only.

Data were collected on growth parameters, namely plant height, number of leaves, number of branches, root length, shoot length, fresh shoot weight, and fresh root weight, as well as on yield parameters, namely number of fruits and total yield. The data were statistically analyzed using Analysis of Variance (ANOVA) with SAS statistical software. Mean comparisons were performed using the Least Significant Difference (LSD) test.

RESULTS AND DISCUSSION

Significant differences ($p<0.05$) were observed across most assessed parameters, indicating varied physiological responses to the applied interventions (Table 1 and 2).

Table 1: Effect of different treatments on growth parameters of Tomato variety "Bathiya"

parameters	Treatments						P value
	T1	T2	T3	T4	T5	T6	

Plant height	104.9^{b}	110.5^{ab}	131.3^{a}	121.5^{ab}	119.6^{ab}	79.1^{c}	0.0047
Number of leaves	156.2^{c}	260.5^{a}	204.2^{b}	250.2^{a}	146.2^{c}	84.5^{d}	0.0001
Number of branches	26.2^{a}	30.0^{a}	24.5^{ab}	29.7^{a}	14.2^{b}	3.5^{c}	0.0005
Root length	37.4^{ab}	34.8^{ab}	41.6^{a}	43.0^{a}	28.5^{ab}	22.9^{b}	0.0881
Shoot length	93.8^{a}	88.9^{ab}	114.9^{a}	103.5^{a}	98.7^{a}	64.0^{b}	0.0371
Fresh shoot weight	114.7^{bc}	171.8^{ab}	251.1^{a}	228.0^{a}	59.3^{c}	33.6^{c}	0.0032
Fresh root weight	4.3^{ab}	5.3^{ab}	16.2^{a}	13.1^{ab}	2.7^{b}	1.1^{b}	0.0104

Means with the same letter across rows are not significantly different at $p<0.05$

As shown in Table 1, treatments T3 and T4 consistently promoted superior vegetative growth. T3 recorded the maximum plant height, significantly exceeding T1 and T6. Similarly, T2 and T4 were most effective in leaf production, followed by T3. Further, there was no significant difference in branching among T1, T2, T3, and T4 whereas, T5 and T6 exhibited significantly fewer branches. For shoot length, all treatments except T6 did not differ significantly. In fresh shoot weight, T2, T3, and T4 were not significantly different. In fresh root weight, T1, T2, T3, T4 were in the same group. Conversely, T6 consistently produced the lowest values across all growth parameters.

Table 2: Effect of different treatments on yield parameters of Tomato variety "Bathiya"

Parameters	Treatments						P Value
	T1	T2	T3	T4	T5	T6	
Number of fruits	17.7^{cd}	39.5^{ab}	30.5^{abc}	51.5^{a}	14.0^{de}	0.5^{e}	0.0001
Total yield	34.5^{ab}	20.5^{ab}	29.9^{ab}	40.3^{a}	16.5^{ab}	10.2^{b}	0.036

Means with the same across rows are not significantly different at $p<0.05$

As depicted in Table 2, Yield data substantiated the trends observed in growth parameters. T4 exhibited the highest fruit production per plant, However, it was not significantly different than T2 and T3 whereas, significantly lowest fruit yield was recorded in T6. When considering total yield, except T6 all other treatments were in a homogeneous group. T6 was less performed.

PBRH enhances the substrate's nutrient-holding capacity, which is vital for tomato growth, as evidenced by studies showing improved plant height and yield with organic substrates (Ayinde *et al*., 2024; Bartz *et al*., 2017). According to Jayarathna *et al*., (2024) the porous structure of PBRH aids in nutrient retention and reduces

leaching, promoting healthier root systems and increased branching. Further, Velusamy *et al*. (2024) reported that the Sand + PBRH + Soil + Coir Dust + Compost treatment yields the highest root growth due to its comprehensive nutrient content and enhanced soil properties. Addition of PBRH consistently outperformed others in terms of growth metrics and yield, likely due to the synergistic effects of multiple organic amendments (Wickramasinghe & Silva, 2019). The findings of the present study align with these reports, suggesting that the observed improvements can be attributed to the combined benefits of diverse components.

CONCLUSIONS/RECOMMENDATIONS

Based on the findings, it can be concluded that the sand + PBRH + soil + coir dust + compost mixture (T4, 1:1:2:1:1), followed by T2 (sand + PBRH + soil, 1:1:2) and T3 (sand + PBRH + soil + coir dust, 1:1:2:1), are the most suitable growth media compositions for cultivating the tomato variety '*Bathiya*' under protected environments. The study further highlights the need for future research to assess the cost-effectiveness of different growth media combinations to ensure sustainable tomato cultivation in protected systems.

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