Cost-Effective Potting Media for Efficient Betel (*Piper betle* L.) Propagation

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Abstract

Betel (Piper betle L.) is a popular intercrop with coconuts in Kurunegala and Gampaha districts, mainly grown as a cash crop. To ensure selection of high quality, vigorous plants, growers often use potted betel plants for transplanting. The traditional potting media for betel consists of equal parts topsoil (TS), sand (S), cow dung (CM) and coconut flour (CD). However, due to the high cost and limited availability of sand and coir dust, using partially burned paddy husk as a substitute is a more economical option. A study was conducted to determine the cost-effective potting mixture using a combination of different potting materials. Seven treatments included the combinations of top soil, sand, cattle manure, coir dust, and partially burned paddy husk (PBPH). The poly bags were filled with a plotting mixture and three nodal cuttings were planted. A propagator was used to raise the plants for 21 days. The small plants were then kept in 70% shade. According to the results, the highest root dry weights were in the T2(TS:CM:S:CD:PBPH 2:1:1:1:3) and T7 (TS:CM:PBPH, 1:1:3). The highest shoot dry weight, shoot length, and number of leaves were all observed in T4 (TS:CM:S:CD 2:1:1/2:1:1). Therefore, treatments T4, T2, and T7 can be recommended for betel propagation. The cost per plant in the T4, T2, and T7 treatments was Rs 13.50, Rs 11.50, and Rs 9.30, respectively, which is lower than the cost of the conventional potting mixture at Rs 18.00.

Keywords: betel,Cost effective potting media, paddy husk

I. INTRODUCTION

Betel (*Piper betle*) is a perennial climbing plant from the Piperaceae family that is widely cultivated and highly valued for its economic and cultural significance in South and Southeast Asia. The leaves of the betel plant are commonly chewed with areca nut and slaked lime, a traditional practice across several Asian countries (Rani & Singh, 2017). Successful cultivation of betel requires specific soil and climatic conditions, making the selection of a suitable potting mix crucial for effective propagation and growth (Manjunatha, 2016). Betel is particularly popular as an intercrop in coconut plantations, serving as a significant cash crop in regions like Kurunegala and Gampaha districts of Sri Lanka (Silva et al., 2018). Many growers prefer to use potted betel plants for transplanting, as this allows them to select high-quality, vigorous plants for field planting (Senanayake & Wijesundara, 2019). In producing these potted plants, the cost, applicability, and availability of the potting media are key factors to consider (Das et al., 2020).

The conventional potting mixture used for raising betel planting materials typically contains a mixture of topsoil, sand, cow dung, and coir dust in a 1:1:1:1 ratio (V/V/V/V) (Wijeratne et al., 2017). However, the use of sand and coir dust has become increasingly uneconomical due to rising costs and limited availability (Kumar et al., 2018). A cost-effective alternative is the substitution of sand and coir dust with partially burned paddy husk, which offers a more affordable and accessible option. To address this, a study was conducted to determine a more economical potting mixture using a combination of different growing materials.

II. METHODOLOGY

The experiment was carried out from July to November 2020 at the Dampellessa Intercropping and Betel Research Station Narammala, located in the low country intermediate zone of (IL1a) of Sri Lanka (7°24'19.0''N, 80°12'15.2''E). Five different potting materials were used: topsoil (TS), cow dung (CM), sand (S), coir dust (CD) and partially burnt rice husks (PBH). These materials were combined in different ratios to create seven potting media mixture treatments (Table 01) with each treatment forty replicates.

Table 01 The different combinations of potting materials (Volume basis)

Treatment	TS	CM	S	CD	PBPH
T1 (Control)	1	1	1	1	0
T2	2	1	1	1	3
T3	1	½	1	1	1
T4	1	1	½	1	1
T5	1	1	1	½	1
T6	1	1	1	0	2
T7	1	1	0	0	3

Healthy semi-mature orthotropic three-node betel branches were obtained from the same variety of mother plants maintained at Narammala Intercropping and Betel Research Station. The potting mixture was filled in polythene bags 20 cm ×12 cm in size, which had perforated at the bottom for drainage. After watered hourly and selected cuttings were planted in polyethylene bags and watered. Stem cuttings were dipped in copper-based fungicide solution before introducing them into the potting mixture to prevent fungal infection at the cut end.

Isolated stem cuttings were placed in a humidity chamber to minimize air circulation and provide 70% shade. After 21 days, the cuttings were transferred from the humidity chamber to a net house with 60% shade, where moisture levels were maintained. Pest and disease control measures were applied as needed. Five plants were randomly selected from each replicate. Starting 35 days after planting, data on the number of shoots, number of leaves, shoot length, number of roots, root length, shoot dry weight, and root dry weight were collected biweekly.

Data was recorded at two weeks intervals at 35 days after planting. The number of shoots, the number of leaves, the shoot length, the number of roots, the root length, the shoot dry weight and the root dry weight were recorded. Newly emerged shoots were separated from the plant and placed in paper bags. The shoot samples were oven-dried at 70°C until a constant weight was achieved, and the weight was recorded using an analytical balance. The vines were uprooted and thoroughly washed. Afterward, the roots were separated from the plant, placed in paper bags, and oven-dried at 70°C until reaching a constant weight. The weight was also measured using an analytical balance. Roots were carefully washed and separated using surgical scissors. Root samples were spread over a 1 cm grid, and root length was measured by counting the number of root intersections with the grid lines, following the method of Tennant (1975)._The data were analyzed using ANOVA and statistical analysis was performed with Minitab 17 software. The least significant different (LSD P = 0.05) was used to compare the treatment means.

III. RESULTS & DISCUSSIONS

Table 02. The growth parameters of betel plant under different potting media

Treatment	Root dry weight (g)	Shoot dry weight (g)	Root length (cm)	Shoot length (cm)
T1	0.08^{c}	0.64^{bc}	83.38^{c}	27.07^{c}
T2	**0.16^{a}**	0.75^{b}	120.04^{ab}	$27.96b^{c}$
T3	0.09^{ab}	0.56^{c}	98.69^{bc}	$28.44b^{c}$
T4	0.12^{ab}	**1.04^{a}**	112.63^{ab}	**44.60^{a}**
T5	0.10^{ab}	0.65^{bc}	100.46^{bc}	33.80^{b}
T6	0.11^{ab}	0.72^{b}	113.04^{ab}	$30.28b^{c}$
T7	**0.16^{a}**	0.75^{b}	**131.81^{a}**	$31.20b^{c}$
CV %	27.31	20.95	14.59	18.93

Note: means followed by the same letters are not significantly different

The highest root dry weights were observed in treatments T2 and T7 (0.16 g), which was significantly higher than T1 (0.08 g) but not significantly different from T3, T4, T5, and T6. The root dry weights of the treatments followed the order of T7=T2>T4>T6>T5>T3>T1 and treatment T1 being the lowest. There was no significant difference between treatments T_7 and T_2.

According to the statistical analysis, there were significant differences ($p<0.05$) between treatments with respect to shoot dry weight. The highest shoot dry weight was recorded at T4 (1.04 g), which was significantly higher than the other treatments and T_3 had the lowest. Shoot dry weights followed the order as T_4>T_2 =T_7 >T6>T5

$>T_1$ $>T_3$ respectively. Treatment T_4 was the highest.

The higher root and shoot dry weights in treatments T2, T4, and T7 can be attributed to the optimal combination of organic components, which provided adequate nutrients and improved soil structure. The high root dry weight in T2 and T7 (with higher proportions of PBPH) suggests that PBPH may enhance root biomass by improving soil aeration and moisture retention. Hossain and Islam (2020) reviewed various agricultural waste residues and concluded that materials like partially burnt paddy husk can improve soil physical properties, including aeration and moisture levels, thereby benefiting root growth and overall plant health. Research indicates that the application of rice husk ash improves soil structure by reducing soil compaction and increasing porosity, which leads to enhanced root growth due to better aeration in maize(Channabasappa et el. 2002*)*.

T7 had the longest root length (131.81 cm), significantly longer than T1 (83.38 cm), which had the lowest. Root length followed the order as T_7 $>T_2$ $>T_6>T_4>T_5>T_3$ $>T_1$ There were no significant differences among the treatments T_2, T_6, T_4, T_5 and T_3. There were significant differences ($p<0.05$) among treatments for shoot length. T4 had the significantly longest shoot length (44.60 cm). Shoot length followed the order of as T_4 $>T_5>$ T_7 $>T_6>T_3>T_2>T_1$ respectively.
There was no significant differences among treatments T_1,T_7,T_6,T_3 and T_2.(Figure.1) here was no significant different among treatments. Treatment T_4 had the highest average number of leaves with respect to other treatments. T_3 had the least average number of leaves.

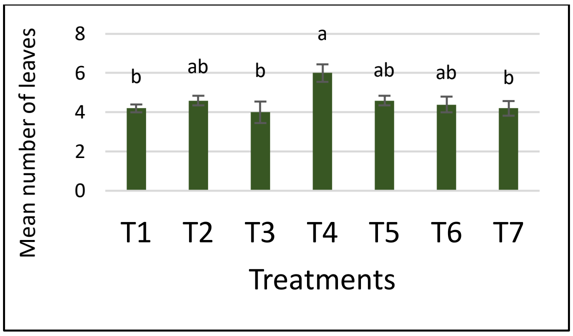

Figure 01. Effects of potting media on the number of leaves of betel plants during 60 days after plating.

Note: means followed by the same letters are not significantly different

T7 exhibited the longest root length, indicating that a higher proportion of PBPH in the mixture may promote root elongation. PBPH is known for its excellent aeration and drainage properties, which can facilitate deeper root growth. T4, with the longest shoot length, suggests that a balanced mixture of coir dust and sand can significantly enhance shoot development.

The positive effects of organic amendments like cattle manure and coir dust on plant growth have been well-documented. The cattle manure significantly improve soil fertility by increasing organic matter content and microbial activity, leading to enhanced plant growth (Ribeiro et al.2016). Similarly, coir dust, a by-product of the coconut industry, has been recognized for its high water-holding capacity and ability to improve soil aeration, which benefits root and shoot development (Awang et al. 2009).

The role of PBH in promoting root growth aligns with findings by *De Costa et al.* (2012), who reported that PBH enhances soil physical properties, such as porosity and permeability, thereby facilitating better root penetration and growth.

Though the sand and coir dust are traditional components of potting mixtures, their high cost and limited availability can be prohibitive. PBPH is a cost-effective alternative with good aeration properties. Studies have shown that PBPH can improve root growth due to its porous nature, which facilitates better oxygenation and drainage

For instance, research by Reddy et al. (2018) found that the incorporation of burnt paddy husk into soil significantly increased root biomass and plant growth by enhancing soil porosity and water management. Additionally, Sharma and Kumar (2020) highlighted that the use of paddy husk in soil amendments led to better oxygenation, which is critical for healthy root development and reduces the risk of root diseases.

The study revealed that different potting mixtures significantly influence the growth parameters of Betel. Treatment T4, comprising a mixture of topsoil, cattle manure, sand, and coir dust, showed superior performance in shoot dry weight and shoot length, indicating its potential as an effective potting mixture for Betel propagation. The maximum production cost (Rs. 18.00) was observed in the T1. Other treatments T2, T3, T4, T6, and T7 cost of production were Rs.11.50 ,Rs. 17.75, Rs.13.50, Rs.17.80, Rs. 15.75 and Rs 9.30. The cost of a plant in the T2, T4 and T7 treatments were Rs.11.50, Rs.13.50, Rs. 9.30 respectively lower than the cost of the conventional potting mixture (T1) Rs18.00.

IV.CONCLUSION

The findings indicate that the inclusion of partially burnt paddy husk (PBPH) in potting mixtures enhances the growth of betel plants, with mixtures containing higher PBPH levels (T2 and T7) demonstrating significant increases in root biomass and length. Additionally, the mixture with a reduced proportion of sand and coir dust (T4) was found to optimize shoot growth. Among the tested combinations, the T4 mixture (1:1:0.5:1:1) emerged as a cost-effective option for betel propagation, providing a balanced blend of nutrients and physical properties that support both root and shoot development. Further research should investigate the long-term impacts of these potting mixtures on plant health and productivity, as well as their cost-effectiveness for large-scale betel cultivation.

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