ISSN: 3029-0724

Research Article

Journal of Environmental Science and Agricultural Research

Identification of Low-Cost Potting Mixture for Propagation of Betel (*Piper Betle L.*)

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Received: September 20, 2024; **Accepted:** October 02, 2024; **Published:** October 07, 2024

ABSTRACT
Betel (*Piper betle L.*) is a popular intercrop with coconut in Kurunegala and Gampaha districts, cultivated primarily as a cash crop. Growers often use potted betel plants for transplanting to ensure the selection of high-quality, vigorous plants. The traditional potting mixture for betel includes top soil(TS), sand(S), cattle manure(CM) and coir dust(CD) in equal parts. 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 carried to find out the low-cost potting mixture using combination of potting materials. Seven treatments comprised 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. Then the small plants were kept in 70% shade. According to the results, the highest root dry weights were observed in T2(TS:CM:S:CD:PBPH 2:1:1:1:3) treatment and T7 (TS:CM:PBPH, 1:1:3)treatments. The highest shoot dry weight was observed in T4 (TS:CM:S:CD:PBPH 2:1:1/2:1:1)treatment. The highest shoot length was observed in T4 treatment. The highest number of leaves was observed in T4 treatment. Therefore treatments, T2 ,T4 and T7 can be recommended for the betel propagation. Cost of a plant in the T2, T4 and T7 treatments were Rs11.5, Rs13.50, Rs 9.30 respectively were lower than the cost of the conventional potting mixture Rs18.00.

Keywords: Betel, Potting Media

Introduction

Betel (*Piper betle*) is a perennial climbing vine in the Piperaceae family, that is of significant economic and cultural importance in South and Southeast Asia. The leaves of the betel plant are often chewed with areca nut and slaked lime, forming a traditional practice in many Asian countries. Certain soil and climatic conditions are required for successful cultivation of betel. Therefore, selecting a suitable potting mix is crucial for effective propagation and growth. Betel is one of the most popular intercrops in coconut plantations grown as a cash crop in Kurunegala, and Gampaha districts. Many growers use potted betel plants for transplanting because they can select high-quality, vigorous plants for field planting. When producing the plotted plants, the cost of the plotting media, applicability and availability were taken into account. Conventional plotting mixture for raising betel planting materials contain topsoil, sand, cow dung and coir dust in a ratio of 1:1:1:1 (V/V/V/V). The use of sand and coir dust in the potting mixture is uneconomical due to high costs and low availability. Substituting sand and coir dust with partially burned paddy husk is more economical. A study was conducted to determine the cost-effective grouting mix using a combination of different grouting materials.

Methodology

The experiment was carried out from July to November 2020 at Dampellessa Intercropping and Betel Research Station, Narammala. The site 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), coconut flour (CD) and partially burnt rice husks (PBH). These materials were combined in different ratios to yield seven potting media treatments (Table 1) with forty replicates.

Citation: DMPV Dissanayaka. Identification of Low-Cost Potting Mixture for Propagation of Betel (Piper Betle L). J Envi Sci Agri Res. 2024. 2(4): 1-3.
DOI: doi.org/10.61440/JESAR.2024.v2.29

Table 1: 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 plant maintained at Narammala Intercropping and Betel Research Station. The potting mixture was filled in polythene bags of 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 to the potting mixture to prevent fungal infection at the cut end. Isolated stem cuttings were kept in a humid chamber to avoid the air circulation to the outside and provide 70% shade. After 21 days, they were removed from humidity chamber and placed in a net house with 60% shade and moisture content maintained. Pest and disease control was carried out when necessary.

Two plants were randomly selected from each replicate. 35 days after planting, number of shoots, number of leaves, shoot length, number of roots, root length, shoot dry weight and root dry weight were collected biweekly.

Data were recorded at two weeks interval 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 immerged shoot parts were separated from plant and they were transferred to paper bags. Shoot samples were over dried at 700C to constant weight. The weight was taken using an analytical balance. Vines were up rooted and washed well. After root were separated from plant and transferred to the paper bags and oven dried at 700C until constant weight. Weight was taken using an analytical balance. Roots were washed and separated carefully using surgical scissor. Root sample were spread on 1cm grid. Root length measurements were made by counting the number of observations of root overlying intersection between 1cm grid lines method [1].

The data were analyzed by using the ANOVA and statistical analysis were performed with Minitab 17 software. The least significant different (LSD P=0.05) was used to compare the treatment means.

Results & Discussions

Table 2: The growth parameters of betel plant under different the potting media

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

Mean within a column with the same letter is not significant at $p<0.005$

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. Root dry weights of treatments followed the order as T7 =T2>T4>T6>T5>T3>T1. and treatment T1 was the lowest. There was no significant difference between treatments T7 and T2.
According to the statistical analysis there were significant differences ($p<0.05$) among treatments with respect to shoot dry weight. The highest shoot dry weight was recorded in T4 (1.04 g), which was significantly higher than the other treatments and T3 had the lowest. Shoot dry weights followed the order as $T_4>T_2=T_7>T6>T5>T_1>T_3$ respectively. Treatment T4 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 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 [2].

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 T7 >T2 >T6>T4>T5>T3 >T1 There were no significant differences among the treatments T2, T6, T4, T5 and T3.

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. here was no significant different among treatments. Treatment T_4 had the highest number of average leaves with respect to other treatments. T3 had the least number of the number of leaves.

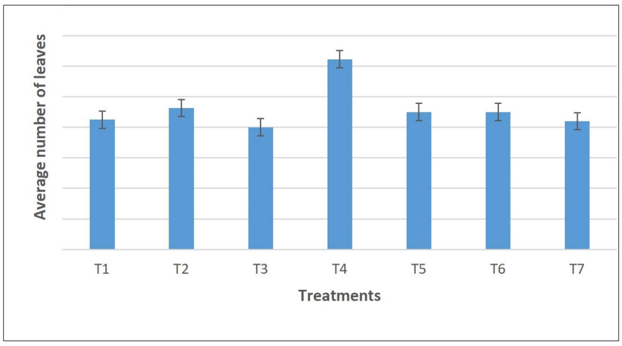

Figure 1: Effects of potting media on average number of leaves of betel

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 [3]. 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 [4].

The role of PBH in promoting root growth aligns with findings by De Costa et al. who reported that PBH enhances soil physical properties, such as porosity and permeability, thereby facilitating better root penetration and growth [5].
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. found that the incorporation of burnt paddy husk into soil significantly increased root biomass and plant growth by enhancing soil porosity and water management [6]. Additionally, Sharma and Kumar 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 [7].

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 Rs11.50 ,Rs. 17.75, Rs13.50, Rs.17.80, Rs.15.75 and Rs 9.30. The cost of a plant in the T2, T4 and T7 treatments were Rs11.50, Rs13.50, Rs 9.30 respectively lower than the cost of the conventional potting mixture (T1) Rs18.00.

Conclusion

The results suggest that incorporating partially burnt paddy husk into potting mixtures can improve the growth parameters of betel plants, mixtures with higher PBPH content (T2 and T7) showed significant improvements in root biomass and length, while a balanced reduction in sand and coir dust (T4) optimized shoot growth. The study identifies T4 (1:1:0.5:1:1) as a promising low-cost potting mixture for the propagation of Betel, offering a balanced combination of nutrients and physical properties conducive to both root and shoot growth. Future research should focus the long-term effects of these mixtures on plant health and productivity, as well as their economic feasibility for large-scale Betel cultivation.

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