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Effect of Planting Media on the Growth of Red Betel (*Piper crocatum* Ruiz) Stem Cuttings

Yuda Ady Baskara [1]✉, Nugraheni Widyawati [1]

[1] Faculty of Agriculture and Business, Satya Wacana Christian University, Salatiga, INDONESIA.

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✉Corresponding Author:
512017038@student.uksw.edu

ABSTRACT

One of the determining factors for the success of red betel stem cuttings is the growing medium used to grow roots and shoots. This study aims to understand the influence of the type of planting media on the growth of roots, shoots, and height of red betel seedlings and to determine the best planting media that supports the growth of red betel roots and shoots. The study was conducted through an experiment using a Randomized Block Design, consisting of 6 types of planting media and each treatment was repeated four times. The treatments were 1. Sand, 2. Soil, 3. Husk biochar, 4. Soil + Husk biochar, 5. Soil + Sand, 6. Husk biochar + Sand. The research data were analyzed using Analysis of Variance and continued with Duncan Multiple Range Test at 5% level. The results showed that the type of media for growing red betel stem cuttings had an effect on root length, number of shoots, available N. The type of planting media that best supports the growth of roots, shoots and plant height of red betel stem cuttings is husk biochar planting media.

1. INTRODUCTION

Red Betel (*Piper Crocatum* Ruiz) is one type of plant that can be used as herbal, especially the leaf of this plant. The content of compounds in the red betel plant are alkaloids, saponins, tannins, flavonoids (Sudewa, 2010). Here are some types of diseases that can be cured by consuming the compounds contained in red betel leaf, namely diabetes mellitus, tumors, coronary heart disease, hypertension and surface wounds that are difficult to heal (Prasetya, 2008). According to Ria *et al.* (2011), red betel plants are used by the community in the form of various types of herbal products that are widely needed in the market. Red betel plants are belong to the Piperaceae family, grow alternately, creeping on fences or surrounding trees. The characteristic of this plant includes a purplish green round stem with no flowering, the leaves are heart-shaped with stalk and at the tip of the leaves is tapered. the surface of the leaves is shiny and is uneven. Seeing from the many

benefits obtained from the red betel as a medicinal plant, is the reason for the need for red betel plant propagation. One example of vegetative propagation of red betel plants is by stem cuttings. The success rate of stem cuttings is very low, because the roots of red betel plants dry up quickly and also die quickly (Wudianto, 1998).

The addition of a combination of growth regulators (PGR) auxin, cytokinin and giberalin on red betel stem cuttings is more effective in stimulating the process of shoot growth and root formation of stem cuttings, compared to using one type of PGR (Kafrawi, 2007). According to Djamhuri (2011), the combination of growth regulators on red betel stem cuttings will affect the success rate and growth of red betel shoots. Stem cuttings on red betel are carried out on pieces of stem segments with the aim of these segments forming roots. Stem cuttings are a simple, easy, and fast method of vegetative propagation because they can produce large numbers of new plants from one parent with the same genetic characteristics as the parent (Werdhany *et al*., 2008).

The growth of red betel stem cuttings is strongly influenced by the type of planting medium. Planting media serves as a place to grow and develop roots and hold nutrients and water for a while. The type and nature of the growing media will affect the availability of nutrients and water in the root area. In the research of (Pitoy *et al*., 2006). Red betel growing media which is derived from a mixture of various organic materials such as soil, husk biochar, sand, has a significant effect on plant height growth, number of leaves, number of books and length of the first segment. So far, there is not much information about the best type of growing media for growing roots and shoots of red betel stem cuttings. This study aims to determine the effect of the type of planting media on the growth of roots, shoots and height of red betel plant and to determine the type of growing media that best supports the growth of roots and shoots of red betel stem cuttings.

2. MATERIALS AND METHODS

2.1. Research Time and Location

This research was conducted at the Kartini Experimental Garden, Faculty of Agriculture and Business, Satya Wacana Christian University. The experimental garden which has an area of 300 m^2 was located at an altitude of 500 meters above sea level. The research location is at Jalan Kartini no 11 Salatiga City, Central Java Province. The research has been carried out in September-December 2021.

2.2. Materials

The materials used include betel plant, water, label paper, polybag, Aquades, LiCi, filter paper, mineral oil, $CaOH_2$, pumice stone, 4% boric acid, H_2SO_4, PA solution, PB solution and PC solution. Red betel leaves are small, reddish green in color and have a very sharp taste, usually used for medicinal mixtures. The red betel used in this study has small leaves, reddish green in color, and has a very sharp taste. This betel is usually used for medicinal mixtures. Morphologically, red betel is characterized by: grooved stems, young stems are green, while old stems are light brown. The type of leaf is single with alternating positions, the leaf blade is oval, the base of the leaf is heart-shaped or rounded, the leaf length is 5-18 cm, and the leaf width is 2.5-10.75 cm. The inflorescence is a compound flower strand with a protective leaf of approximately 1 mm, and is both male and female. Seeds are stone-like, round, and grayish-green in color, 1-1.5 cm thick, slightly rounded seeds, 3.5–5 mm long.

Planting media used in red betel stem cuttings are 1 Sand, 2 Soil, 3 Husk Biochar, 4 Soil + Husk Biochar, 5 Soil + Sand, 6 Husk Biochar + Sand. The ratio of the planting media used is 1:1.

Some of the tools used in this research were digital thermometer, ruler, marker, pulp, knife, pH meter, measuring cup, shovel, plastic bucket, camera, flam photometer, shaker, Kjeldahl flask, distillation, Beaker glass and absorbance.

2.3. Design of Experiment

The experiment was carried out using 6 types of planting media treatment consisting of sand (P), soil (T), husk biochar (S), soil + husk biochar (TS), arrow + sand (TP), and husk biochar + sand (SP). The research was arranged in 4 blocks, each block consisted of 6 plots, and each plot had 4 replicates of plant samples so that there were 96 plants in total, as presented in Figure 1.

Block 1	Block 2	Block 3	Block 4
P1-P4	T1-T4	S1-S4	TS1-TS4
T1-T4	S1-S4	TS1-TS4	TP1-TP4
S1-S4	TS1-TS4	TP1-TP4	SP1-SP4
TS1-TS4	TP1-TP4	SP1-SP4	P1-P4
TP1-TP4	SP1-SP4	P1-P4	T1-T4
SP1-SP4	P1-P4	T1-T4	S1-S4

Figure 1. Lay out of growing media treatments for red betel experiment

2.4. Planting and Maintenance

The red betel stem is cut into two segments (with a length of 8-10 cm), where each segment still has leaves. To reduce transpiration, the leaves from stem cuttings were cut in half (Lusiana *et al*., 2013). Red betel stem cuttings that have been prepared were then deepen in water for 15 minutes. The cuttings were planted in polybags in an upright position with a depth of 1/3 of the stems into the planting medium. The cuttings were then given a plastic cover for one week in order to avoid being exposed to rainwater directly (Lusiana *et al*., 2013).

Maintenance activities include the process of watering and controlling weeds that grow around the stems of the red betel plant. The media was watered every 2 days using a measuring cup with a volume of 50 ml, which was carried out in the afternoon. If the conditions are moist in the planting medium, watering is not carried out. Weed control is carried out manually by removing weeds that grow around the base of the red betel (Lusiana *et al*., 2013). The red betel harvesting process is carried out after 80 days after planting (DAT). The results of harvesting red betel were observed and analyzed.

2.5. Observation and Measurement

Soil temperature was measured using a soil thermometer and soil moisture was observed using soil tester at a depth of 2-5 cm. Soil temperature measurements were carried out every day at 12.00 -14.00 PM on all planting media. Measurement of soil moisture is carried out once every 2 days, namely in the morning at 07.00-09.00 AM

and in the afternoon at 15.00-16.00 PM. Determination of available N, available P, available K and Total Pore Space (TPS) were measured at the end of the study at the Soil Laboratory, Faculty of Agriculture and Business. The number of roots and root length were measured at the end of the study by pulling the red betel root from the polybag and measured using a ruler. The number of shoots was observed every week by counting the number of shoots in each planting medium. Shoot height was measured every day in the afternoon using a ruler.

2.6. Data Analysis

All research data obtained were analyzed by analysis of variance. If the results of the analysis are significant, proceed with the DMRT test at 5% level. The research data collected were soil temperature, soil moisture, available N, available P, available K, total pore space, number of roots, root length, number of shoots and shoot height.

3. RESULTS AND DISCUSSION

3.1. Soil Temperature and Soil Moisture

Based on the results of the analysis of variance on soil temperature and soil moisture, it showed that the growing media had a significant effect on soil temperature and soil moisture. Data on soil temperature and soil moisture are presented in Table 1.

Table 1. Effect of planting media on the soil temperature and soil moisture in planting media

Growing Media	Soil Temperature (°C)	Soil Humidity (%)
Sand	26.00 b	58.75 bc
Soil	24.00 ab	57.00 bc
Husk biochar	30.50 a	49.50 c
Soil + Husk biochar	23.75 ab	49.00 c
Soil + Sand	22.50 c	61.75 b
Husk biochar + Sand	22.00 c	83.25 a

From Table 1, it can be seen that the use of planting media types of soil + sand and husk biochar + sand resulted in low soil temperatures during the day and the most humid soil moisture, when compared to sand, soil, burnt husks and soil + husk biochar. This happens because the solar heat energy that enters the soil can come out through the gaps between the charred husks, sand and stems of the red betel plant, so that heat does not accumulate in the polybag. In addition, the high humidity of the growing media also causes the soil temperature to not easily increase significantly due to the presence of water in the growing media. The relatively higher soil moisture is caused by the lower evapotranspiration process, so that over time the organic matter that stores water in the soil can be filled with water. Compared to charred husk type planting media which cannot hoald enough water, so the humidity is low.

According to (Sudewo, 2010) red betel grow well at an average daily temperature of 33.50 °C, and an average daily humidity of 72.78%. According to (Table 1) the weekly average of air temperature and humidity in the research location is not optimal for red betel. For a maximum air temperature of 31.94 °C and the humidity achieved is

only 2 times, namely week 8 and 9 with humidity of 73.29% and 75%. Therefore, the growth of red betel is still not optimal, resulting in stunted growth of red betel plants.

3.2. Total NPK Available and Total Pore Space

The results of analysis of variance on available N, available P, available K and total pore space showed that red betel growing media had a significant effect on available N. While the growing media did not have a significant effect on available P, available K and total pore space. Duncan test results at 5% level of available N, available P, available K and total pore space are presented in Table 2.

Table 2. Effect of planting media on N available, P available, K available and Total Pore Space

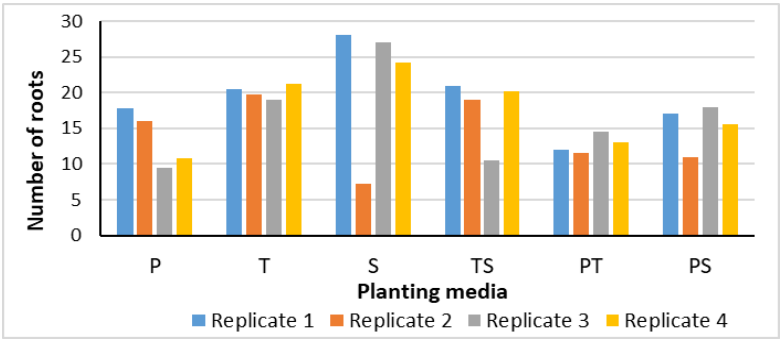
Growing Media	N Available (%)	P Available (%)	K Available (%)	Total Pore Space (%)
Sand	0.03b	0.10b	0.11b	55%
Soil	0.08b	0.22b	0.13b	69%
Husk biochar	0.30a	0.16b	0.38a	91%
Soil + Husk biochar	0.04b	0.89a	0.12b	75%
Soil + Sand	0.04b	0.50ab	0.18ab	60%
Husk biochar + Sand	0.09b	0.45ab	0.11b	80%

In addition to environmental factors, optimal plant growth is also influenced by nutrient factors in the growing media. Table 2 shows the growing media with different treatments in testing available N, available P, available K and total pore space. Planting media types of biochar husk and biochar + soil have available N 0.30, available K 0.38, and total pore space 91%, higher than those of other planting media. According to (Wisyastuti 2020) red betel cutting media using roasted husk can increase porosity, drainage, and nutrient absorption by plant roots. According to (Kuntilek *et al*., 2006) micro pores occupy the most space in the soil pores, the soil pore system is strongly influenced by soil organic matter, clay content, humidity and also the type of roasted husk planting media.

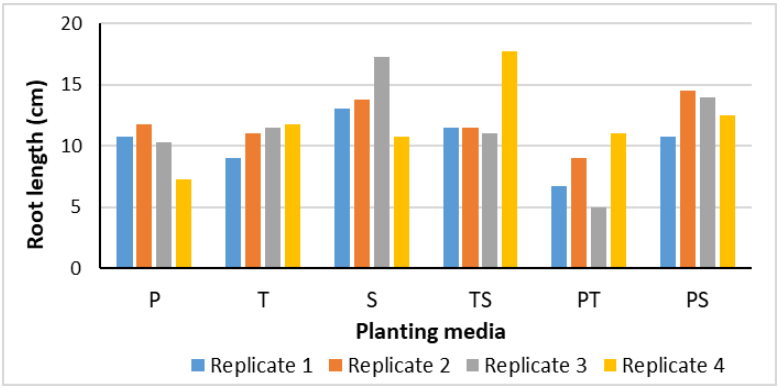
Nitrogen is a macro nutrient needed by most plants. Nitrogen is absorbed in the form of nitrate ions because these ions are negatively charged so that they are always in the soil and are easily absorbed by plant roots. According to (Brattacharyya et al., 2008) the distribution of nitrogen content in soil is closely related to differences in soil parent material, climate and how to manage planting media.

According to (Brattacharyya et al., 2008) the availability of phosphate in the soil is influenced by many factors, but the most important is soil pH. Phosphate will react with calcium ions and form potassium phosphate which is difficult to dissolve so that it cannot be absorbed by plants in soils that have a high or alkaline pH (Dhage et al., 2014). Of the three macros that are absorbed by plants (N, P, K) potassium is the most abundant on the earth's surface, about 1-10% is trapped in soil colloids because potassium is positively charged, the rest is only 1-2% present and soluble in soil and available to plants (Ispandi, 2000). K nutrient is not easily transferred to most soils, the movement and movement of K nutrients is mainly through the diffusion process.

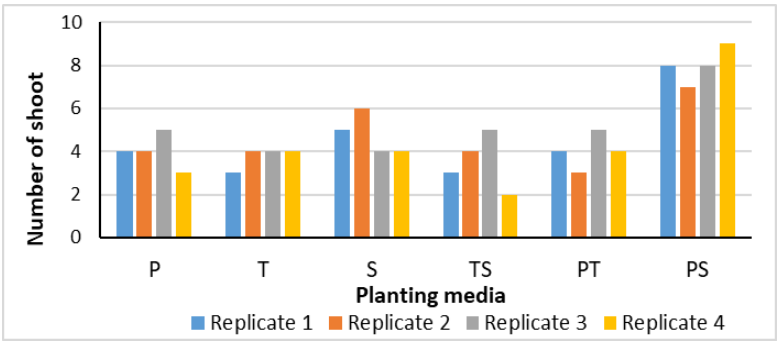
Number of root



Root length



Number of shoot



Shoot height

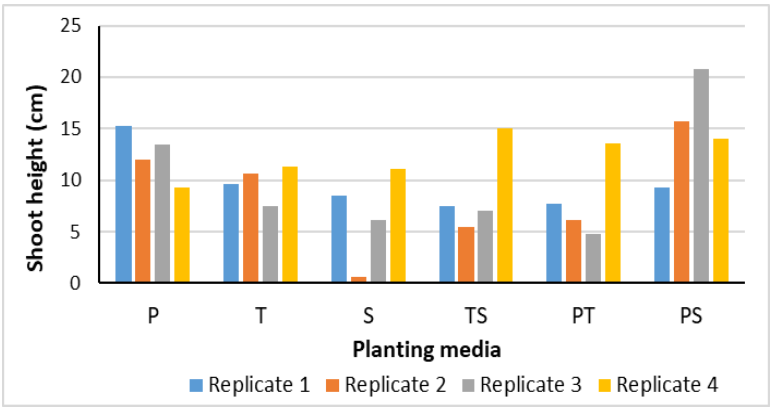


Figure 2. Effect of different planting media on the growth of red betel stem cutting (P: sand; T: soil; S: husk biochar; TS: soil + husk biochar; PT: sand + soil; PS: sand + husk biochar)

3.4. The Growth of Red Betel Stem Cuttings

Figure 2, shows the growth development of red betel stem cuttings for 80 days represented by number of roots, root length, number of shoots, and shoot height. From Figure 3 it can be seen that number of roots and root length, types of husk biochar planting media are relatively the same. The difference is only seen from the growth speed, where the treatment planting media type of husk biochar produce more shoots and significantly higher than those of other types of planting media. The advantage of using husk biochar type planting media is that it can increase porosity and drainage. This is in accordance with the opinion (Wisyastuti, 2020). Planting media of husk biochar can increase porosity, drainage, and nutrient absorption by plant roots.

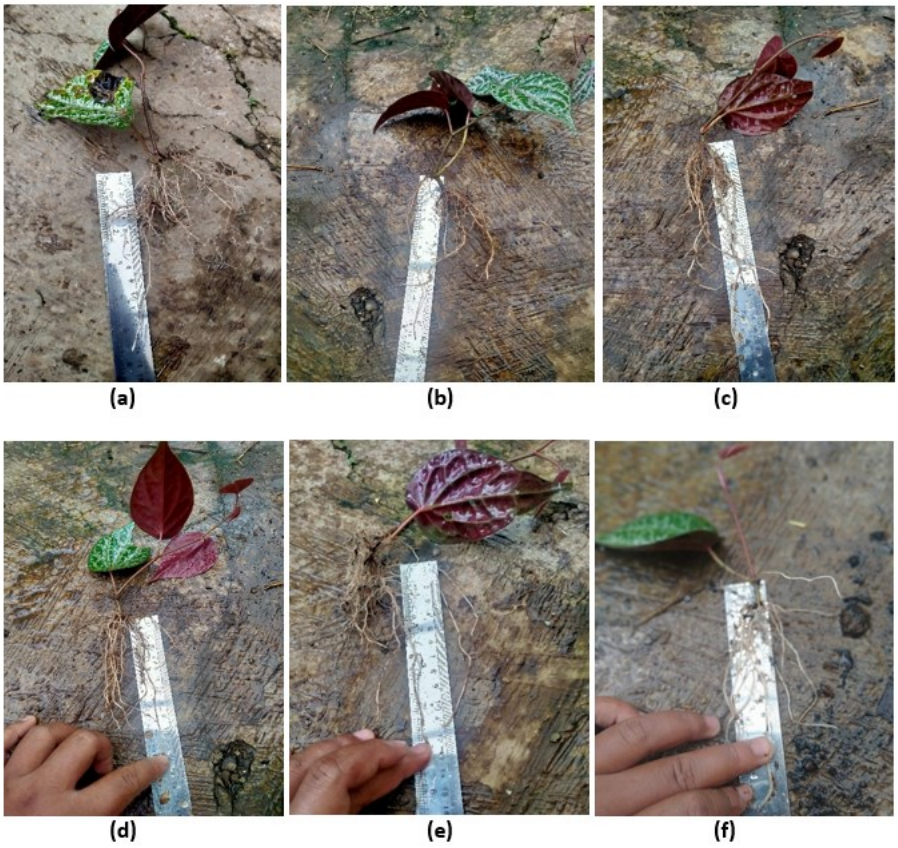


Figure 3. Number of roots and root length of red betel plant after harvesting at 80 DAT based on growing media: (a) Sand, (b) Soil, (c) Husk biochar, (d) Soil + Husk biochar, (e) Soil + Sand, (f) Sand + Husk biochar.

3.3. Number of Roots and Root Length

Based on the results of the analysis of variance on the planting medium, it was found that the planting medium did not have a significant effect on the number of roots and root length of the red betel plant. Duncan test results at 5% level regarding the number of roots and root length are presented in (Table 3). Based on Table 3, it can be explained that the planting media of husk biochar showed the highest number of roots, compared to the planting media of sand, soil, soil + husk biochar, soil + sand, husk biochar + sand. This is in accordance with the nature of the burnt husk which can

increase the porosity of the water and absorb more nutrients. This is in accordance with the opinion (Wisyastuti, 2020). Red betel growing media using husk biochar can increase porosity, drainage, and nutrient absorption by plant roots. Planting media type soil + sand showed the lowest yield for all parameters of the number of roots. This is presumably because the soil + sand type of planting media is more moist and too dense so that plant roots are difficult to grow. This is in accordance with research conducted by (Sudewo, 2010) that the planting media that is storing more water can cause the roots and rootstock of the red betel plant to rot.

Table 3. Effect of planting media on the number of roots and root length

Growing Media	Number of Roots	Root Length (cm)
Sand	13.50 b	10.00 ab
Soil	20.12 ab	10.81 ab
Husk biochar	21.62 a	13.68 a
Soil + Husk biochar	17.68 ab	12.93 ab
Soil + Sand	12.75 b	7.93 b
Husk biochar + Sand	15.37 ab	12.93 ab

Based on Table 3, the type planting media treatment of husk biochar showed the highest root length yield compared to the planting media of sand, soil, soil + husk biochar, soil + sand, husk biochar + sand. This is in accordance with the opinion (Susilowati, 2007) who showed that the husk biochar growing media on Red betel plants gave higher average plant height growth and stem parameters compared to other treatments. Figure 3 presents root length of red betel for different planting media treatments.

Table 4. Effect of planting media on the number of shoots and height of shoots

Growing Media	Number of shoots	Plant height (cm)
Sand	4.00 b	12.50 ab
Soil	3.75 b	9.77 ab
Husk biochar	4.77 b	6.59 b
Soil + Husk biochar	3.50 b	8.75 b
Soil + Sand	4.00 b	8.06 b
Husk biochar + Sand	8.00 a	14.93 a

3.5. Number of Shoots and Height of Shoots

Based on analysis of variance about **t**he planting medium showed that the planting medium had a significant effect on the number of shoots and shoot height of red betel stem cuttings. Results from DMRT test at 5% level regarding the number of shoots and shoot height are presented in Table 4. Cuttings on red betel are carried out on pieces of stem segments with the aim of forming plant roots and shoots. Each part of the red betel can be used as a cutting material because it has the potential to contain different growth regulators, especially cytokinins and auxins. According to (Sudewo, 2010). The young plant parts tend to produce more shoots than the old plants due to the higher auxin content compared to the old plant parts. Based on the results of Table 4, it is husk biochar, husk biochar + sand. This is because the husk + sand planting medium has nutrient binding properties. According to opinion (Ramlah, 2019). Explaining that husk + sand has advantages as a growing medium, including holding nutrients longer,

improving soil structure and increasing water porosity.

Vitamins are additional nutrients and one of the important substances necessary for the body and plant height. Plants need vitamins to support the growth and development of plant organs. This is in accordance with the opinion of (Fitzpatrick et al., 2020). Explaining that in the absence of energy, plant growth processes, such as cell division, new tissue formation, and root growth and shoot height cannot occur. The results of Table 4, explain that the planting medium of husk biochar + sand produces the highest shoot height compared to the planting media of sand, soil, husk biochar, soil + husk biochar, soil + sand.

4. CONCLUSION

Various types of growing media affect on the soil temperature, soil moisture, available N, number of shoots and shoot height. The use of growing media that can increase the yield of red betel stem cuttings is a type of husk biochar growing media because it causes available N, available K, total pore space, number of roots and root length. Red betel stem cuttings with husk biochar as planting media produced 0.30% available N, 0.38% available K, 91% total pore space, 21.62 roots and 13.68 cm root length. Results of the study concluded that husk biochar + sand was the best growing medium for red betel stem cuttings with highest number of shoots (8.0) and highest shoot height of 14.93 cm.

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