Effect of planting media on the growth of red betel (Piper crocatum) cutting

T Widyastuti*, B H Isnawan and S R Adawiyah
Department of Agrotechnology, Faculty of Agriculture, Universitas Muhammadiyah Yogyakarta, Brawijaya Road, Kasihan, Bantul, Yogyakarta 55183, Indonesia.

*E-mail: titiekw@yahoo.co.id

Abstract. Red betel is a plant that is cultivated by many people in Indonesia. Vegetative propagation of red betel through cuttings usually has a low success rate because it is affected by the planting medium used. This research aimed to determine the best planting medium for the growth of red betel cutting. The medium used was soil, sand, compost, husk charcoal, coconut coir and fractional tile which made in various combinations, i.e., M1 (soil + compost), M2 (soil + husk charcoal), M3 (soil + coconut coir), M4 (soil + sand + compost), M5 (soil + sand + husk charcoal), M6 (soil + sand + coconut coir), M7 (soil + fractional tile + compost), M8 (soil + fractional tile + husk charcoal) and M9 (soil + fractional tile + coconut coir). The results showed that the planting medium affected the growth of red betel cutting. M2 (soil + husk charcoal) treatment showed the best effect to support the growth of red betel cuttings.

1. Introduction
Red betel (Piper crocatum Ruiz and Pav.) is a common medicinal plant in Indonesia. This plant can also be cultivated as ornamental plant because of its attractiveness. Furthermore, this plant can act as an antioxidant, antihyperglycemic, anti-cancer, anti-diabetes, and anti-bacterial [1] because it is containing flavonoids, alkaloids, polyphenolic compounds, essential oils, tannins and steroids [2-4]. Therefore, preference of people to this plant is increasing and the opportunity to develop the cultivation of red betel is interesting to be studied.

Red betel can be propagated vegetatively in various ways such as graftings, layerings, or cuttings [5]. The advantage of propagation by cutting is that it can produce plant seeds that have similarities in age, size and resistance to pests and diseases. Moreover, the propagation of red betel by cuttings method is cheap and easy, however the success rate of vegetative propagation of red betel through cutting is very low [6]. The success probability of red betel cutting is about 40-70% [7]. In plant cultivation, planting medium play an important role for plant growth and its health. One of the conditions for a good growing medium is to have high porosity or water absorption ability. For example, a mixture of fern and fractional tile with a ratio of 1:1 in orchids gives greater average number of leaves, the number of bulb and the number of roots than other treatments [8], and a mixture of rice husk charcoal, soil and compost with a ratio of 1:2:1 on Zinnia elegans provide the fastest growing speed than other medium used [9]. Gustiyudha [10] said that planting red betel cuttings using soil, sand, and manure planting medium with a ratio 1:3:1 can increase the percentage of live cuttings. But the lack of using this planting medium has not increased the average number of roots and the number of red betel leaves.
Various planting medium such as soil, compost, husk charcoal, coconut coir, sand and fractional tile can be used among others. Each type of planting medium has different capacity to store nutrients and water [11]. Mixing two or more planting medium is expected to provide a suitable medium for the growth of red betel cutting and can produce a high percentage of life. Therefore, this research was conducted to study the growth of red betel cutting in various planting medium with different physical characteristics.

2. Materials and Methods

2.1. Research Design
This research was designed by a completely randomized design. The treatments were arranged as a single factor consisting of treatments as follow:

1. M1: soil + compost
2. M2: soil + husk charcoal
3. M3: soil + coconut coir
4. M4: soil + sand + compost
5. M5: soil + sand + husk charcoal
6. M6: soil + sand + coconut coir
7. M7: soil + fractional tile + compost
8. M8: soil + fractional tile + husk charcoal
9. M9: soil + fractional tile + coconut coir

According to those treatments, the respective planting medium is mixed with 1:1 ratio. We mixed those respective medium until homogeneous. The mixture of planting medium then put into polybags as much as 3/4 of its volume. All treatments were replicate 3 times.

2.2. Red Betel
Betel seeds used originated from the parental plant which was planted in the experimental field of the Faculty of Agriculture, Universitas Muhammadiyah Yogyakarta. To get new seeds, the stems of plants that have a leaf are cut. Then, the tip of the stem of the prospective seedling was smeared with root growth stimulating hormone (Root-Up). 1/3 of the seedling stem section is then planted on the planting medium. Fertilization was done in the seven weeks after planting. Gandasil was used for fertilization with a dose of 3 grams per 5000 ml of water. In addition, plants were observed every day to ensure there are no pests or diseases attack. Weeding and watering was also done as a maintenance effort. The parameters observed were plant height, number of leaves, number of roots, root length, root fresh weight, root dry weight, shoot fresh weight, shoot dry weight, shoot-root ratio, plant fresh weight, plant dry weight, live cuttings.

2.3. Statistical Analysis
All parameters were analyzed using analysis of variance. The means were separated with Duncan’s Multiple Range Test at the 5% level.

3. Results and Discussion
The results of this research showed that the medium used showed a significant effect to the growth of red betel cutting including plant height (F = 4.98, df = 8, P < 0.01), number of leaves (F = 4.34, df = 8, P = 0.01), shoot fresh weight (F = 4.72, df = 8, P < 0.01), shoot dry weight (F = 3.52, df = 8, P = 0.01), plant fresh weight (F = 5.49, df = 8, P < 0.01), plant dry weight (F = 4.64, df = 8, P < 0.01) and the percentage of living shoot (F = 25.94, df = 8, P < 0.01). However, there was no significant different on the number of roots (F = 1.30, df = 8, P > 0.05), root length (F = 1.22, df = 8, P > 0.05), root fresh
weight ($F = 1.09$, $df = 8$, $P > 0.05$), root dry weight ($F = 1.96$, $df = 8$, $P > 0.05$) and shoot-root ratio ($F = 0.75$, $df = 8$, $P > 0.05$) as well.

**Table 1.** Effect of various planting medium on the growth of red betel cutting

| Planting medium | Plant height (cm) | Number of leaves | Living shoot (%) | Shoot fresh weight (g) | Shoot dry weight (g) | Plant fresh weight (g) | Plant dry weight (g) |
|-----------------|-------------------|------------------|------------------|-----------------------|---------------------|-----------------------|---------------------|
| M1              | 13.50 bc          | 1.00 c           | 11.11 b          | 1.64 c                | 0.30 c              | 3.97 b                | 0.63 d              |
| M2              | 25.21 a           | 5.77 a           | 100.00 a         | 5.70 a                | 1.23 a              | 8.66 a                | 2.10 a              |
| M3              | 8.47 c            | 1.50 c           | 88.89 a          | 1.64 c                | 0.42 bc             | 3.60 b                | 0.90 d              |
| M4              | 6.75 c            | 4.00 abc         | 22.22 b          | 2.93 abc              | 0.58 bc             | 6.23 ab               | 1.30 bcd            |
| M5              | 21.48 ab          | 5.66 a           | 100.00 a         | 5.16 ab               | 0.98 ab             | 7.94 a                | 1.96 ab             |
| M6              | 8.25 c            | 2.33 bc          | 100.00 a         | 1.72 abc              | 0.39 bc             | 4.04 b                | 1.06 cd             |
| M7              | 11.25 bc          | 3.50 abc         | 33.33 b          | 2.70 bc               | 0.55 bc             | 5.46 ab               | 1.16 cd             |
| M8              | 21.30 ab          | 5.11 ab          | 100.00 a         | 5.52 ab               | 1.02 ab             | 8.40 a                | 1.73 abc            |
| M9              | 8.47 c            | 2.00 bc          | 88.89 a          | 1.81 c                | 0.43 bc             | 3.29 b                | 0.97 cd             |

Means followed by different letters are significantly different (DMRT, $\alpha = 5\%$)

Among all treatments tested, red betel cutting grows better in the mixture of soil + husk charcoal (M2) planting medium. The shoot which grow in M2 medium grow higher than the other medium used. In term of the number of leaves, the shoots planted on this medium also have more leaves than plants planted on other medium, resulting they have fresh and dry weight of shoot and plant heavier than other medium used. Furthermore, all shoots planted in this medium have higher survival rate (all shoot live until the end period of research). When the soil mixed with husk charcoal, it will produce planting medium that have high porosity and low water holding capacity and it can increase the absorption of nutrients by the roots. In addition, the development of plant height (Figure 1) planted in M2 medium also showed the best growth of red betel cuttings than it planted on the other medium used (Figure 2).

![Figure 1. Development of red betel cuttings height](image)

Other medium such as the mixture of soil + sand + husk charcoal (M5) and the mixture of soil + fractional tile + husk charcoal (M8) also showed similar result with M2 medium. According to , the effectiveness of planting medium varies depending on physical characteristics of medium itself. Soil is a common medium used in plant propagation, soil texture has an important role in determining root penetration, infiltration of water into the soil, water holding capacity, rate of water and air movement.
in the soil [12]. According to [13], sand is used in a mixture of medium to help improve soil aeration. The presence of sand can cause the medium to become less moist so that the plant roots do not rot quickly [14]. However, sand is a planting medium that is very easy to lose water because of the presence of macro pores. Thus, the level of media moisture is reduced. The mixture of fractional tiles in the medium can help to increase water absorption so that media moisture becomes more stable. The addition of husk charcoal is done to prevent water loss. Husk charcoal can increase groundwater reserves and can increase levels of potassium and magnesium exchange. The black color of this media can also absorb sunlight effectively. Husk charcoal is a good planting medium because it contains 52% C, 31% SiO2, 32% N, 0.15% phosphate, 0.31% potassium, and 0.96% calcium. It also contains Fe, Mn, and Zn as much as 180 ppm, 80.4 ppm, and 14.10 ppm respectively. Meanwhile, fractional tiles are used to support the red betel root system. The presence of this media can also regulate the humidity of the rooting area and to absorb water and nutrient solutions [15].

![Figure 2. The growth of red betel cuttings on various planting media used](image)

| Planting media | Number of roots | Root length (cm) | Root fresh weight (g) | Root dry weight (g) | Shoot-root ratio |
|----------------|----------------|------------------|-----------------------|---------------------|-----------------|
| M1             | 12.00          | 19.50            | 1.34                  | 0.33                | 1.10            |
| M2             | 15.00          | 21.44            | 2.73                  | 0.88                | 0.79            |
| M3             | 19.66          | 15.58            | 1.84                  | 0.46                | 1.08            |
| M4             | 15.50          | 26.25            | 3.29                  | 0.72                | 1.54            |
| M5             | 16.55          | 20.28            | 2.64                  | 0.94                | 0.99            |
| M6             | 17.33          | 16.33            | 2.32                  | 0.67                | 1.45            |
| M7             | 13.00          | 18.00            | 2.67                  | 0.61                | 1.71            |
| M8             | 19.00          | 22.72            | 2.90                  | 0.70                | 0.71            |
| M9             | 12.44          | 17.94            | 1.45                  | 0.56                | 1.29            |

Table 2. Effect of various planting medium on the growth of root of red betel cutting
Meanwhile, various kinds of planting medium mixtures used has the same effect on the growth of root of red betel cutting. The planting medium does not have significant effect on the number of roots, root length, fresh and dry weight of root, so also the shoot-root ratio. This might happen because even though each planting medium used is made in a different mixture, the main planting medium used is soil.

4. Conclusion
The planting medium affects the growth of red betel cuttings. Among all media used, the mixture of soil and husk charcoal is the best planting media that can support the growth of red betel cutting.

References
[1] Safithri M, Fahma F 2008 Hayati J. Biosciences 15(1) 45-48.
[2] Alfarabi M, Bintang M, Safithri M 2010 Hayati J. Biosciences 17(4) 201-204.
[3] Safithri M, Yasni S, Bintang M, Ranti AS 2012 Hayati J. Biosciences 19(1) 31-36.
[4] Sugiharti NP 2007 Aktivitas Antibakteri Ekstrak Daun Sirih Merah (Piper crocatum) (Bogor: IPB University).
[5] Reveny J 2011 Jurnal Ilmu Dasar 12(1) 6-12.
[6] Werdhany W, Marton A, Setyorini W 2008 Sirih Merah (Yogyakarta: Balai Pengkajian Teknologi Pertanian Yogyakarta).
[7] Sudewo B 2010 Basmi penyakit dengan sirih merah (Jakarta: AgroMedia).
[8] Sriyanti 1989 Jurnal Budidaya Pertanian 1(1) 34-42.
[9] Susilawati E 2007 Pengaruh komposisi Media terhadap Perkecambahan dan Pertumbuhan Tanaman Helichrysum Bracleatum dan Zinnia Elegans (Bogor: IPB University).
[10] Gustiuydha M 2009 Teknik perbanyakan tanaman sirih merah (Piper crocatum) secara cangkok (Surakarta: Fakultas Pertanian. Universitas Sebelas Maret).
[11] Junaedhie K 2006 Pesona Anthurium Daun (Jakarta: AgroMedia).
[12] Daubenmire R 1948 Plants and environment. A Textbook of Plant Autecology. (London: John Wiley and Sons, Inc.).
[13] Irawan A 2003 Hidroponik Bercocok Tanam Tanpa Media Tanah (Bandung: M2S).
[14] Henuhili V 2008 Manfaat Dan Penggunaan Kompos Pada Media Tanam (Yogyakarta: Fakultas Matematika dan Ilmu Pengetahuan Alam. UNY).
[15] Fahmi ZI 2013 Media Tanam sebagai Faktor Eksternal yang Mempengaruhi Pertumbuhan Tanaman (Surabaya: Balai Besar Perbenihan dan Proteksi Tanaman Perkebunan).