The effect of cutting material and planting medium to the growth of cinnamon (*Cinnamomum zeylanicum* Blume) seedling

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Abstract. Cinnamon can be propagated generatively and vegetatively. Vegetative propagation will generate the similar characteristics as its parent tree, hence facilitating the providing of high quality seedling. The research objective was to obtain the suitable vegetative propagation technology for cinnamon by cutting. The research was conducted at Cimanggu Research Installation, ISMCRI, Bogor from January to December 2018. The experiment was designed in randomized block design, 2 factors and 3 replications. The first factor was cutting materials: shoot cutting from 1) the 1st-2nd node 2) the 3rd-4th node and 3) the 5th-6th node. The second factor was planting medium 1) manure: husk charcoal: soil (2: 1: 1), 2) manure: cocopeat: soil (2: 1: 1), and 3) water. The shoot cutting from the 5th-6th node indicated better plant growth than from the 1st-2nd node, although not significantly different from the 3rd-4th node. Cuttings grown in water medium indicated no new shoot emergence until the last observation. However, cuttings planted in charcoal or cocopeat media, grew well and showed no significant differences in all parameters. Cinnamon plant can be propagated vegetatively by cutting using shoot cuttings from 5th-6th node or the 3rd-4th node grown in media contained husk charcoal or cocopeat.

Keywords: *Cinnamomum zeylanicum*, shoot cuttings, vegetative propagation

1. Introduction

Cinnamon (*Cinnamomum zeylanicum* Roxb.) is one of the important spices and export commodity in Indonesia. The central producer is Jambi especially in Kerinci District. Cinnamon has many uses as powder, essential oil or oleoresin. Cinnamon’s bark powder is commonly used as spices, but it also has medicinal efficacy to decrease cholesterol level and prevent the increase of sugar level in the blood. Oleoresin of cinnamon can be utilized in the industry of food, beverage, pharmacy, cigarette and cosmetics [1]. The essential oil or oleoresin contains cinnamaldehydes, eugenol, methyl ketene, furfural, benzaldehyde, nonyl aldehyde, hydrocinnamic aldehyde, cinnaldehyde, and coumarin [2]. However, the quality of seedling is still a problem in cinnamon cultivation. Farmers in producer centre area are still using unqualified seed (*benih sapuan*), hence the yield and productivity is fluctuated.
Cinnamon can be propagated generatively (seeds) and vegetatively (layering, cutting, suckering and tissue culture) [3]. Generative propagation has some disadvantages such as the plant characteristic might be different from parent tree. Furthermore, cinnamon seed belongs to recalcitrant seed, meaning the seed has to be planted immediately. Otherwise, its viability will decline rapidly [4].

Meanwhile, vegetative propagation has advantages; the similar genetic characteristics as parent tree, seed can be produce anytime independent from fruiting season, easy seed provision and in large quantities, produce yield faster than seed propagated-plants. However, plant root was usually shallow and widespread, although it will develop following plant age [5]. Furthermore, vegetative propagation is also useful for developing clone bank (genetic conservation) [6].

Shoot cutting is one of alternatives to propagate cinnamon. The success of shoot cutting is affected by external and internal factors such as plant growth regulator (PGR) [7] and planting medium [8]. Planting medium affected significantly adventive root growth and shoots. Cutting success rate was also determined by plant species, cutting types, plant part (node) and season [9]. Planting medium commonly used for cutting were solid medium (soil, cocopeat, husk, manure) and liquid medium (water) [10].

The objective of the research was to obtain the suitable vegetative propagation technology for cinnamon by cutting.

2. Material and method

The study was conducted from April to December 2018 in Cimanggu Research Installation, Indonesian Spices and Medicinal Crops Research Institute (ISMCR), Bogor (229 m asl). Plant material was obtained from parent tree grown in Cimanggu Research Installation. The study was arranged in completely randomized design (CRD), 2 factors repeated 3 times. The first factor was the cutting materials (S): the shoot cutting from 1) the 1st-2nd node 2) the 3rd-4th node and 3), the 5th-6th node. The second factor was planting medium (M) : 1) manure: husk charcoal: soil (2: 1: 1), 2) manure: cocopeat: soil (2: 1: 1), and 3) water. The shoot cutting treatments were chosen following [11], whereas the planting medium was commonly used in forest trees vegetative propagation such as mahogany [12] and eaglenwood [13] with modification. Cuttings was planted in polybag for treatment 1 and 2, while for treatment 3 used plastic cups filled with water. The number of cuttings per plot was 50. Each cutting was covered with plastic for 3 months to promote rooting. The rooted seedlings with 2 leaves (3 months old) were then transplanted into polybags filled with soil and manure (1: 1) and fertilized with NPK 3 g/plant at the time of transplanting. The parameters observed were live cuttings percentage, plant height, stem diameter, number of leaves, leaf length, leaf width and leaf thickness, measured every 2 weeks. The data were analyzed by ANOVA and tested further with Duncan Multiple Range Test (DMRT) at 5% level.

3. Result and Discussion

3.1 The percentage of rooted cutting and live cuttings

The percentage of rooted and live cuttings of cinnamon was not affected by cuttings material but by planting media. Cutting grown in water (M3) showed the lowest percentage of rooted and live cuttings and significantly different from other media treatments (Table 1). The percentage of live cutting at 19 weeks after planting (WAP) ranged from 1-46%. The percentage of live cuttings during the study decreased every week (Figure 1).

![Figure 1. Percentage of live cuttings of cinnamon on several cutting material (S) and planting medium (M) treatments.](image-url)
Table 1. Percentage of live cuttings of cinnamon on several cutting material (S) and planting media (M)

| Treatments                   | Rooted cuttings* | Live cuttings** |
|------------------------------|------------------|-----------------|
| Cutting material (S)         |                  |                 |
| the 1st-2nd node (S1)        | 35.16            | 35.16           |
| the 3rd-4th node (S2)        | 36.09            | 31.40           |
| the 5th-6th node (S3)        | 41.59            | 29.51           |
| Planting media               |                  |                 |
| Manure: husk charcoal: soil (2: 1: 1) (M1) | 58.72 a | 43.39 a |
| Manure: cocopeat: soil (2: 1: 1) (M2) | 50.41 a | 39.78 a |
| Water (M3)                   | 0.00 b           | 10.97 b         |
| CV                           | 37.63            | 45.75           |

*at 9 weeks after planting (WAP); ** at 19 WAP; ***data were transformed with arcsin(x+1)

Numbers followed by the same letter in the same column were not significantly different at DMRT 5%

The percentage of rooted cuttings was influenced by planting media. Cuttings grown in water medium had the lowest percentage of rooted cuttings (0%), whereas for other treatments was more than 50% (Table 1). Based on the observations, only 2 cuttings were rooted in water medium treatment (S1M3). However, root performance was not as good as other media treatments (Figure 2). Beside the high percentage of plant death, cuttings grown in water medium did not indicate plant growth.

Figure 2. Rooted cuttings on several planting media treatments.

The percentage of live cuttings planted in M1 and M2 treatments ranged from 60-80%, whereas for M3 (water) was 20-50% (Figure 1). Plant died while in rooting process might be caused by nutrient competition with weed since plants cannot be weeded while in the rooting process. Furthermore, it also might be triggered by pest infestation indicated by fungi infection showed by the presence of white spots on the stem of cuttings.

3.2. Growth of cinnamon cuttings

The treatment of cuttings and media significantly affected the plant height parameters at 19 weeks after transplanting (WAT), although there was no interaction between the two factors (Table 2). Cuttings from the 5th-6th node (S3) provided significantly better plant height than those from the 1st-2nd node (S1), although not significantly different from the 3rd-4th node (S2) treatments. The husk charcoal media (M1)
and cocopeat (M2) gave a significant effect on plant height compared to water media (M3), although the M1 and M2 treatments were not significantly different. Cuttings planted in water medium did not grow shoots until 19 WAT, hence no data on growth parameters (Table 2 and Figure 3).

Stem diameter increment and leaf number were not affected by cuttings material but affected by planting media (Table 2). The cuttings grown on water medium (M3) did not form new shoots until 19 WAT (Figure 3), while the planting media using husk charcoal did not have a significant effect of stem diameter increment and leaf number compared to cocopeat (Table 2).

![Figure 3. Plant height and leaf number of cinnamon cuttings at several cutting materials and planting media treatments](image)

**Table 2. The growth of cinnamon cuttings at 19 weeks after transplanting at several cutting material and planting media treatments**

| Treatments                  | Plant height (cm) | Stem diameter increment (mm) | Leaf number |
|-----------------------------|-------------------|-----------------------------|-------------|
| Cutting material (S)        |                   |                             |             |
| the 1st-2nd node (S1)       | 4.95 b            | 0.04                        | 4.02        |
| the 3rd-4th node (S2)       | 5.92 ab           | 0.04                        | 5.15        |
| the 5th-6th node (S3)       | 6.56 a            | 0.04                        | 5.35        |
| Planting media              |                   |                             |             |
| Manure: husk charcoal: soil (2: 1: 1) (M1) | 11.25 a       | 0.06 a                      | 9.05 a      |
| Manure: cocopeat: soil (2: 1: 1) (M2) | 9.96 a         | 0.06 a                      | 8.49 a      |
| Water (M3)                  | 0.00 b            | 0.00 b                      | 0.00 b      |
| CV                          | 10.83             | 0.74                        | 13.42       |

Data were transformed with arcsin(x+1)

Numbers followed by the same letter in the same column were not significantly different at DMRT 5%.

In general, the length, width and thickness of the leaves were not affected by cuttings material, but were influenced by the planting medium (Table 3, Figure 4). The cuttings grown in the water medium (M3) do not grow new shoots hence the growth parameters were not measurable. The performance of leaf shoot of cuttings grown on planting media containing husk charcoal and cocopeat was not significantly different (Table 3).
Table 3. Leaf performance of cinnamon cuttings at 19 weeks after transplanting in several treatments
of cutting materials and planting media

| Treatments                      | Leaf length (cm) | Leaf width (cm) | Leaf thickness (mm) |
|---------------------------------|------------------|-----------------|--------------------|
| Cutting material (S)            |                  |                 |                    |
| the 1st-2nd node (S1)           | 3.37             | 1.50            | 0.10               |
| the 3rd-4th node (S2)           | 3.41             | 1.56            | 0.10               |
| the 5th-6th node (S3)           | 3.28             | 1.59            | 0.10               |
| Planting media                  |                  |                 |                    |
| Manure: husk charcoal: soil (2:1:1) (M1) | 5.86 a | 2.61 a | 0.17 |
| Manure: cocopeat: soil (2:1:1) (M2) | 5.92 a | 2.61 a | 0.17 |
| Water (M3)                      | 0.00 b           | 0.00 b          | 0.00               |
| CV                              | 3.27             | 2.13            | 0.38               |

data were transformed with arcsin(x+1)
Numbers followed by the same letter in the same column were not significantly different at DMRT 5%

In general, cutting material showed no significant effect on cinnamon cutting growth up to 19 WAT except for plant height parameter. Several factors affected cuttings success included cutting material age (juvenility), position and diameter of the cuttings, the environment (planting medium, temperature, light, and humidity) and also nutrients [14] [15]. The S3 treatment (the 5th-6th node) or the lower part was thought to have a high food reserve and carbohydrate content for vegetative growth such as plant height and number of leaves.

The growth of root and shoot of the cuttings was affected by food reserves and carbohydrate content of parent trees [9]. Height increment was the ability of plants to grow and form young tissue from plant parts and determine the formation of carbohydrates as food reserves [16]. The cutting material from middle part of betel branch (Piper betle) gave significant effect of seedling growth compared to cuttings material from shoots [17].

However, planting media significantly affected the growth of cinnamon cuttings, because cinnamon cuttings planted in water media did not grow new shoots, even though the husk charcoal and cocopeat showed no significant differences on the growth of cinnamon cuttings. Manure: husk charcoal: soil (2:
The composite of top soil : husk charcoal contained pH \( H_2O \) (6.66), pH KCL (5.25), N (0.36%), organic C (5.30), whereas top soil: cocopeat has a pH content of \( H_2O \) (6.59), pH KCL (5.45), N (0.01%), organic C (5.97) [19]. Both media had no distinct differences except for N content. Nitrogen required by plants still be able fulfilled from manure and soil, hence it did not significantly affect the observed parameters.

The used of water as growth medium for cinnamon cutting propagation might need extra treatment. The success to propagate Eucalyptus sp. through stem cutting in water medium (rooting 76%) was reported in another study [20], although the cuttings were protected by shading net. In this study, the cuttings were not protected by shading net, hence water temperature might be too high for cuttings to grow shoot and root. Daily temperature was about 22.3-32.5°C with relative humidity around 79.1% [21]. Moreover, the water medium might also to be unable to provide adequate nutrients and plant growth regulator (PGR) needed for cuttings growth [22]. Thus, extra treatment such as application of PGR will enhance root and shoot growth of cinnamon cutting in water medium.

4. Conclusion
Cinnamon can be propagated vegetatively using cuttings from the 3rd-4th node or the 5th-6th node using planting media contained husk or cocopeat charcoal. Cinnamon cuttings grown in water medium was suggested to be pre-treated with PGR to promote root and shoot growth and protected from heat using shading net.

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