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ORIGINAL ARTICLE

Establishment and Optimization of Plant Growth Media for the Propagation of Mas Cotek (*Ficus deltoidea* Jack var. *trengganuensis*)

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Abstract

The propagation of Mas Cotek using tissue culture techniques is time-consuming and requires specific conditions. Therefore, this study was conducted to determine the best rooting media formulation to propagate Mas Cotek under field conditions. First, the effects of plant growth media (rice husk biochar (RHB), bris soil, cocopeat (CC), peatmoss, and a mixture of 3CC: 7RHB) on plant traits were investigated. Subsequently, the optimal ratio of CC and RHB for Mas Cotek propagation was carried out. In addition, the evaluation of the traits of the Mas Cotek plant when grown with the mixture of 3CC: 7RHB enriched with different rooting-promoting materials (effective microorganism, Agromedia™, Indole-3-butyric acid (IBA), organic fertilizer, peatmoss, and seasol) was also performed. Plant growth variables measured were the total number of roots, length, plant biomass, chlorophyll content, and stem diameter. Planting media characters observed were soil pH, soil electrical conductivity, and plant growth media biomass. The results showed that Mas Cotek propagated best in the combination of 3CC:7RHB growth media added with IBA. This plant growth media has enhanced the total root, root length, plant biomass, root biomass, stem diameter and chlorophyll content of the plant seedlings. The pH of plant growth media (7.00-neutral) and electrical conductivity (0.61 mS/m) are also suitable for growing many types of plants. Findings will help farmers choose the best plant growth media to propagate their plant seedlings.

Keywords: Mas Cotek, Ficus Deltoidea, Plant Growth Media, Plant Propagation, Rooting

Introduction

Mas Cotek or Ficus deltoidea (Moraceae) is an evergreen shrub native to Southeast Asia. This plant species is widely spread in Malaysia, Thailand, Java, Sumatera, Kalimantan, Sulawesi, Maluku Islands, Borneo, and the Philippines (Fatihah et al., 2012; Starr et al., 2003; USDA, 2020). In Malaysia, this plant is locally called as Mas Cotek due to its "golden spots" that occur on the upper surface of the leaves (Musa, 2005). The Malaysian Ministry of Agriculture and Food Industries (MAFI) has identified Mas Cotek as one of ten potential herbs that can be produced on a large scale by the agricultural sectors due to its potential as a medicinal and pharmaceutical source (NPCB, 2015).

The dried Mas Cotek leaves are commonly sold as herbal tea in Malaysia. Traditionally, women consume Mas Cotek herbal tea after childbirth to reinforce their uterus and restore their energy (Fatihah et al., 2012). In addition, Mas Cotek leaves extract is believed to naturally increase fertility for both men and women (Fatihah, 2012). Furthermore, many literatures reported that the decoction of Mas Cotek leaves could boost the blood supply in the human body. This decoction also has high antioxidants and anti-diabetic properties and may be aphrodisiac (Adam et al., 2011; Norhaniza et al., 2007; Sulaiman et al., 2008). A report shows that the antimicrobial and antioxidant properties of Mas Cotek are highly influenced by its phenolic and flavonoid content (Fatihah et al., 2012). These medicinal benefits have encouraged farmers to cultivate Mas Cotek in mass production to fulfill the nutraceutical industry's needs.

Mas Cotek is commonly propagated using micro or in-vitro propagation (Sa'adan and Zainuddin, 2020; Zakiah et al., 2018). However, this technique needs frequent subculture, and it is time-consuming. On the other hand, the propagation of Mas Cotek using seeds is tricky as it rarely produces fertile seeds. Furthermore, Mas Cotek belongs to the fig's family, which flowers need to be pollinated by agaonid wasp. However, this wasp has yet to occur in bris soil area; thus Mas Cotek grown in bris soil area commonly does not have seeds (Starr et al., 2003).

A few research studies have investigated the techniques to propagate Mas Cotek in the bris soil area, including observing the usage of rooting media to propagate Mas Cotek under field conditions. The critical factor that influences the rooting of stem cuttings is the growth medium or the rooting medium (Ingram et al., 1993). The effectiveness of rooting in any plant cutting is influenced by the interaction of variables in the growth media, such as water, oxygen, and nutrients availability (Alikhani et al., 2011; Bhardwaj et al., 2014). Several works have shown the impacts of growth media on the rooting capacity of stem cuttings on several economically important plants (Akinyele, 2010; Ibironke and Victor, 2016; Jacygrad et al., 2012; Tchoundjeu et al., 2002; Usman and Akinyele, 2015; Wojtusik et al., 1994). According to Nava et al. (2014), plant roots need an excellent drainage system but do not cope well with moist and soggy soil, affecting root growth. Therefore, it is vital to propagate plants in a suitable rooting media. Thus, healthy roots could be produced for the plant seedlings' survival.

Mas Cotek can be propagated in many types of plant growth media. However, different types of media will yield different rates of plant growth. Hence, this study aimed to determine the best formulation of plant growth media for the propagation of Mas Cotek under field conditions. The results obtained will help farmers to propagate healthy plants for mass production.

Materials and Methods

Material Research

The study was carried out at the Faculty of Bioresources and Food Industry, Universiti Sultan Zainal Abidin Malaysia (5°45'13.2"N 102°37'39.4"E). The seedlings were grown under a rain shelter with a 70% shaded netted structure. The mother plant of Mas Cotek was obtained from an abandoned oil palm estate at Tembila, Terengganu, Malaysia (5°43'18.2"N 102°39'25.5"E). Ninety Mas Cotek cuttings (3-inch length each) were made from the mother plant and transplanted into the polystyrene box (495 mm (L) × 375 mm (W) × 335 mm (H) × 30 mm (T)) filled with different plant growth media according to the experiment.

The planting layout for all experiments in this study was done using the randomized complete block design (RCBD). All treatments were replicated five times. The plant cuttings were sown at a 1.5-inch depth and watered once per week using a 1-liter spray bottle. The laboratory study was done at the Plant Physiology Laboratory, Universiti Sultan Zainal Abidin (5°45'15.3"N 102°37'41.3"E).

The effects of plant growth media on plant traits

The treatments to evaluate the effects of plant growth media on the plant traits were (1) rice husk biochar (RHB), (2) BRIS soil, (3) cocopeat (CC), (4) peatmoss, (5) sand, and (6) the 3CC: 7RHB. All types of plant growth media were placed into a polystyrene box and left for two weeks to stabilize before being used for the experiment. After 30 days of propagation, the leaves' chlorophyll content was measured. The SPAD-502 portable chlorophyll meter was used to rapidly estimate leaf chlorophyll content, as explained by Lah *et al.* (2011) and Sarwar *et al.* (2013). Afterward, the plant seedlings were harvested. The morphological data for the plant, including the total number of roots, root length, plant biomass, root biomass, and stem diameter, were measured. The stem diameter was measured at the base of the stem. The roots were washed under running tap water to remove all dirt and then wiped dry. The total number of roots was recorded using manual counting. Root length was individually measured from the base of the plant, from the soil surface to the tip of the bottom primary root. All plant parts were dried up in an oven at 60°C. The samples were weighed every day using an electronic weighing machine (TANITA-KD 200) until a constant weight was obtained for the dry weight data.

The physicochemical properties of plant growth media, including the media biomass, pH, and electrical conductivity (EC), were measured. The media biomass was determined according to Thompson *et al.* (2003). Five grams of fresh plant growth media were dried in the oven at 120°C until a constant weight was achieved using an electronic weighing machine (TANITA-KD 200). The pH of plant growth media was taken on the first day after the plant cutting was planted in the polystyrene box. The electrical conductivity (EC) was measured by using a portable electrical conductor by inserting the EC detector directly into the media.

The optimal ratio of cocopeat (CC) and rice husk biochar (RHB)

The treatments for this experiment were (1) 1CC: 0RHB, (2) 7CC: 3 RHB, (3) 1CC: 1RHB, (4) 3CC: 7RHB, and (5) 0CC: 1RHB. All treatments were treated in the same manner, as explained in section 1. The data on plant traits and physicochemical properties for this experiment were described in section 1.

The effects of adding rooting-promoting materials into plant growth media

A mixture of 3RHB: 7CC was used for this experiment. The media were placed into the polystyrene box and left for two weeks to stabilize before being used for the experiment. Then, the media were added with either (1) effective microorganism (EM), (2) Agromedia™, (3) Indole-3-butyric acid (IBA), (4) organic fertilizer (chicken manure), (5) peatmoss, and (6) seasol. The control had no material added.

The EM used in this experiment contained more than 60 microorganisms, including lactic acid bacteria (*Lactobacillus plantarum, Lactobacillus casei* and *Streptocous lactis*), photosynthetic bacteria, yeast and algae. Meanwhile, seasol used in this study was purchased from Seasol International Pty Ltd, Australia. The product was derived from *Durvillaea potatorum* (brown algae) which contains raw protein (2.5 ± 0.1 % w/w), alginates (6 ± 2 % w/w), nitrogen (0.10 ± 0.05 % w/w); phosphorus (0.05 ± 0.02 % w/w); potassium (2.0 ± 0.5 % w/w); copper (0.3 ± 0.2 % w/w) and cytokines. The product has total solidity of 10.0 ± 0.5 % (w/w) with the pH of 10.5 ± 0.5 % (w/w). For the treatments of EM, IBA, and seasol, the stem cuttings were moistened with water and dipped into the solutions for 30 minutes before being planted. Meanwhile, 10% of Agromedia™ and organic fertilizer treatments were mixed with the media and left for two weeks before the experiment. All treatments were treated in the same manner, as explained in Section 1. The data on plant traits and physicochemical properties for this experiment were described in section 1.

Data analysis

The data obtained were subjected to statistical analysis using R studio version 4.0.3 (R Core Team 2020); which types of plant growth media were set as explanatory variables. All data were assessed and transformed when necessary to correct outliers and assumption failures of normality and homoscedasticity. We conducted pairwise comparisons of least-square means and separation by posthoc Tukey tests to calculate the significant differences between the mean values.

Results and Discussion

In general, we found that the type of plant growth media and their added materials influenced the propagation performance of Mas Cotek. It was observed that all plant cuttings grown in all treatments produced 100% rooting. However, the plant traits' performances differed between treatments after one month of planting.

The effects of plant growth media on plant traits

Table 1 shows the total number of roots, root length, plant biomass, root biomass, chlorophyll content, pH electrical conductivity, media biomass, and stem diameter measured in all treatments. The treatment used was T1 (rice husk biochar (RHB)), T2 (BRIS soil), T3 (3RHB:7CC), T4 (cocopeat (CC)), T5 (peatmoss) and T6 (sand).

According to the result, there was no significant difference in pH between all treatments. There was no significant difference between T1, T3, and T5, but a significant difference with T2, T4, and T6 in total root and chlorophyll content. Meanwhile, the Mas Cotek cuttings grown in T1 (14.48 ± 0.12) had the highest mean in the length of root followed by T5 (14.38 ± 0.07), but there was no significant difference between both of them. Then, T3 (11.36 ± 0.64) followed, but there were significant differences from others. Additionally, the Mas Cotek cuttings grown in T1 (1.64 ± 0.01) had the highest mean in plant biomass followed by T3 (1.56 ± 0.02), but there was no significant difference between them. Then, T5 (1.50 ± 0.02) had no significant difference from T3, but there were significant differences between others. There was a significant difference between T1 and other treatments for the root biomass and stem diameter. There was no significant difference between T1 and T5 in electrical conductivity and media biomass, but a significant difference for T2, T3, T4, and T6. Meanwhile, for T3, there was a significant difference from others in electrical conductivity. Meanwhile, Mas Cotek cuttings grown in T1 (4.66 ± 0.009) had the highest stem diameter mean.

According to Mustapha *et al.* (2017), BRIS soil is classified as a dry, nutrient-poor soil with poor physicochemical properties. Still, it contains many microorganisms such as bacteria that live in the rhizosphere of plants. Moreover, BRIS soil's high temperature and dry conditions negatively affect beneficial soil microorganisms' diversity and productivity (Mustapha *et al.*, 2017). The rice husk biochar was the best rooting media for the propagation of Mas Cotek followed by peatmoss. Biochar increases the ability of soil to hold the water, having its most remarkable effects in soil with a poor water-holding ability, such as sandy soils (Ling *et al.*, 2011; Wang *et al.*, 2019). Biochar enhances the supply of soil nutrients and increases the number of nutrients consumed from the soil by plants. Biochar decreases soil acidity and improves the ability of plants to consume the majority of nutrients. In addition, biochar provides an incentive for nutrient ions to transfer from the minerals into the water by increasing water retention, from which plants would absorb them (Brakels *et al.*, 2010).

The performance of plant traits for the plant propagated in a mixture of 3RHB: 7CC was nearly similar to biochar and peatmoss in terms of root length and root biomass compared to the plant propagated in bris soil, cocopeat, and sand. The electrical conductivity in the plant growth media also showed the same pattern. The mixture of 3RHB: 7CC as plant growth media to propagate Mas Cotek is the best in minimizing the production cost as it is the cheapest, and the source of materials is abundant. In addition, the current market price for 10 kg of plant growth media used in this treatment was RM 31.80 for peatmoss, RM 7.70 for cocopeat and RM15.00 for rice husk biochar.

The optimal ratio of cocopeat (CC) and rice husk biochar (RHB)

Table 2 shows the total number of roots, root length, plant biomass, root biomass, chlorophyll content, pH, electrical conductivity, media biomass and stem diameter measured in this experiment. The treatments carried out were T1 (1CC: 0RHB), T2 (7CC: 3RHB), T3 (1CC: 1RHB), T4 (3CC: 7RHB), and T5 (0CC: 1RHB). According to the result, there was no significant difference in terms of pH between treatments. There were no significant differences between T2, T3, T4, and T5. However, there were significant differences with T1 in total root and root length. The Mas Cotek cuttings grown in both T4 (11.40 ± 0.51) and T5 (11.40 ± 0.75) had the highest mean in total roots followed by T2 (9.80 ± 0.37). T2 had significant difference from T1 but not with others. T5 (14.72 ± 0.38) had the highest mean in the length of roots, followed by T4 (12.22 ± 0.48), T2 (11.36 ± 0.64), T3 (9.90 ± 0.55), and T1 (4.46 ± 0.38). Additionally, T1 had a significant difference compared to others. Mas Cotek cuttings grown in T4 (4.74 ± 0.01) had the highest mean in stem diameter, but it was not significantly different than T2, T3 and T5. Meanwhile, Mas Cotek cuttings grown in T1 (4.35 ± 0.01) had the significantly lowest mean in stem diameter compared to other treatments.

For each observed plant cuttings, the plant rooting against the media combination suggested distinct responses. Mas Cotek had the highest number of total roots and longest root length when propagated in 100% rice husk biochar (T5). The optimal cocopeat and biochar application rates depended on the particular type of soil and the management of crops. The informal observations of crop growth between 5-20% by soil volume after the biochar applications were consistently positive and visible results (Glaser *et al.*, 2002). The combination of 3RHB: 7CC was chosen for the next experiment as the results obtained showed that this plant growth media combination produced nearly similar plant traits performance to T5.

The effects of adding rooting-promoting materials into plant growth media

Table 3 shows the total number of roots, root length, plant biomass, root biomass, chlorophyll content, pH, electrical conductivity, media biomass and stem diameter measured in this experiment. The treatments carried out were (T1) control, (T2) effective microorganism (EM), (T3) Agromedia™, (T4) Indole-3-butyric acid (IBA), (T5) organic fertilizer, (T6) peatmoss, and (6) seasol. Based on the result, there was no significant difference in terms of pH between all treatments. The result showed that the addition of IBA in plant growth yielded the best performance compared to other treatments. The cuttings of Mas Cotek grown in T4, in which the rooting media was added with IBA, showed the highest means in all plant traits parameters compared with the others. Additionally, other variables in T4 did not significantly differ from other treatments except root length and stem diameter. Moreover, T4 had a significantly highest mean in root length.

In most plant species, the presence of natural auxin in plants (IAA) is responsible for the induction of rooting. Still, the application of synthetic hormones such as IBA has been more successful than IAA. Its tremendous impact on rooting and growth efficiency in various types of plants is due to its greater tissue stability and storage (Blythe *et al.*, 2007; Ling *et al.*, 2013). The results also showed that T4 was the highest means in root length, plant biomass, root biomass, and stem diameter. Furthermore, the stem cuttings of *F. deltoidea* treated with media consisting of IBA exhibited significant rooting percentage and total fresh and dry biomass (Abhijeet and Mokat, 2018)

Table 1. The effects of plant growth media on plant traits

Treatment	Total Root	Root Length (cm)	Plant Biomass (g)	Root Biomass (g)	Chlorophyll Content (SPAD)	pH	Electrical conductivity (mS/m)	Media Biomass (g)	Stem Diameter (mm)
T1	12.20 ± 0.58^{ace}	14.48 ± 0.12^{ae}	1.64 ± 0.01^{ac}	1.13 ± 0.03^{a}	39.10 ± 0.59^{ace}	7.00 ± 0.00^{a}	0.83 ± 0.01^{ae}	3.29 ± 0.02^{ae}	4.66 ± 0.01^{a}
T2	4.20 ± 0.58^{bdf}	2.70 ± 0.17^{bdf}	1.23 ± 0.003^{bdf}	0.79 ± 0.002^{bdf}	21.42 ± 0.50^{bdf}	6.98 ± 0.00^{a}	0.16 ± 0.01^{bdf}	4.29 ± 0.06^{bcdf}	3.92 ± 0.01^{bf}
T3	9.80 ± 0.37^{ace}	11.36 ± 0.64^{c}	1.56 ± 0.02^{ace}	0.96 ± 0.02^{ce}	33.46 ± 1.38^{ace}	7.05 ± 0.00^{a}	0.41 ± 0.02^{c}	4.10 ± 0.01^{bcdf}	4.18 ± 0.02^{c}
T4	3.80 ± 0.37^{bdf}	3.86 ± 0.21^{bdf}	1.25 ± 0.006^{bd}	0.79 ± 0.01^{bdf}	23.02 ± 0.26^{bdf}	7.01 ± 0.00^{a}	0.24 ± 0.01^{bdf}	4.23 ± 0.01^{bcdf}	4.05 ± 0.01^{d}
T5	10.40 ± 0.51^{ace}	14.38 ± 0.07^{ae}	1.50 ± 0.02^{ce}	0.92 ± 0.01^{ce}	37.86 ± 0.27^{ace}	7.08 ± 0.00^{a}	0.83 ± 0.01^{ae}	3.29 ± 0.02^{ae}	4.54 ± 0.0^{e}
T6	2.40 ± 0.40^{bdf}	3.24 ± 0.23^{bdf}	1.12 ± 0.01^{bf}	0.79 ± 0.01^{bdf}	21.66 ± 0.42^{bdf}	6.96 ± 0.00^{a}	0.15 ± 0.01^{bdf}	4.30 ± 0.06^{bcdf}	3.83 ± 0.01^{bf}

T1: Rice Husk Biochar (RHB), T2: Bris Soil, T3: Mixture of 7CC: 3RHB, T4: Cocopeat (CC), T5: Peatmoss and T6: Sand. Data are presented in Means ± S.E. Means within the same column of different line followed by the same letter, do not differ significantly according to the post-hoc Tukey tests at 0.05.

Table 2. The optimal ratio of cocopeat (CC) and rice husk biochar (RHB)

Treatment	Total Root	Root Length (cm)	Plant Biomass (g)	Root Biomass (g)	Chlorophyll Content (SPAD)	pH	Electrical conductivity (mS/m)	Media Biomass (g)	Stem Diameter (mm)
T1	3.40 ± 0.68^{a}	4.46 ± 0.38^{a}	1.33 ± 0.02^{abcd}	0.63 ± 0.0^{a}	23.12 ± 0.88^{abc}	6.95 ± 0.02^{a}	0.25 ± 0.01^{a}	4.13 ± 0.01^{ab}	4.35 ± 0.01^{a}
T2	9.80 ± 0.37^{b}	11.36 ± 0.64^{b}	1.40 ± 0.03^{abcd}	0.90 ± 0.02^{b}	33.46 ± 1.38^{abcde}	7.01 ± 0.03^{a}	0.41 ± 0.02^{b}	4.10 ± 0.01^{abc}	4.64 ± 0.01^{bcde}
T3	8.80 ± 0.37^{b}	9.90 ± 0.54^{b}	1.49 ± 0.03^{abcde}	0.86 ± 0.03^{b}	31.04 ± 0.91^{abcde}	7.02 ± 0.03^{a}	0.48 ± 0.02^{b}	3.97 ± 0.01^{bcd}	4.54 ± 0.01^{bc}
T4	11.40 ± 0.51^{b}	12.22 ± 0.48^{b}	1.51 ± 0.03^{abcde}	0.97 ± 0.03^{b}	36.70 ± 1.04^{bcde}	7.02 ± 0.01^{a}	0.95 ± 0.02c	3.94 ± 0.02^{cd}	4.74 ± 0.01^{bde}
T5	11.40 ± 0.75^{b}	14.72 ± 0.38^{b}	1.64 ± 0.01^{cde}	1.00 ± 0.02^{b}	40.10 ± 1.84^{bcde}	6.99 ± 0.03^{a}	0.93 ± 0.01c	3.53 ± 0.03^{e}	4.71 ± 0.02^{bde}

T1: 1CC: 0RHB, T2: 7CC: 3RHB, T3: 1CC: 1RHB, T4: 3CC: 7RHB, and T5: 0CC: 1RHB. Data are presented in Means ± S.E. Means within the same column of different lines, followed by the same letter, do not differ significantly according to the post-hoc Tukey tests at 0.05.

Table 3. The effects of adding rooting-promoting materials into plant growth media

Treatment	Total Root	Root Length (cm)	Plant Biomass (g)	Root Biomass (g)	Chlorophyll Content (SPAD)	pH	Electrical conductivity (mS/m)	Media Biomass (g)	Stem diameter (mm)
T1	9.80 ± 0.37^{abcdeg}	10.78 ± 0.38^{a}	1.32 ± 0.01^{a}	0.80 ± 0.04^{a}	36.42 ± 0.38^{a}	7.02 ± 0.00^{a}	0.41 ± 0.01^{abg}	4.03 ± 0.01^{abe}	4.23 ± 0.01^{af}
T2	9.60 ± 0.51^{abcdeg}	10.30 ± 0.26^{a}	1.25 ± 0.01^{a}	0.83 ± 0.01^{a}	32.72 ± 0.60^{a}	7.01 ± 0.00^{a}	0.48 ± 0.02^{abeg}	3.97 ± 0.01^{abeg}	4.44 ± 0.01^{bg}
T3	10.80 ± 0.58^{abcdeg}	11.04 ± 0.22^{a}	1.50 ± 0.0^{b}	0.93 ± 0.01^{a}	42.66 ± 0.50^{b}	7.10 ± 0.00^{a}	0.61 ± 0.01^{cdefg}	3.65 ± 0.02^{cd}	4.58 ± 0.02^{ce}
T4	13.00 ± 0.71^{abcde}	16.22 ± 0.44^{b}	1.61 ± 0.02^{b}	0.94 ± 0.01^{a}	44.98 ± 0.65^{b}	7.00 ± 0.00^{a}	0.61 ± 0.01^{cdefg}	3.70 ± 0.02^{cd}	4.78 ± 0.01^{d}
T5	10.40 ± 0.51^{abcdeg}	10.44 ± 0.31^{a}	1.26 ± 0.01^{a}	0.83 ± 0.01^{a}	32.60 ± 0.39^{a}	7.00 ± 0.00^{a}	0.59 ± 0.02^{bcdefg}	3.92 ± 0.01^{abeg}	4.64 ± 0.01^{ce}
T6	4.80 ± 0.37^{fg}	9.92 ± 0.27^{a}	1.24 ± 0.02^{a}	0.86 ± 0.01^{a}	41.08 ± 0.36^{b}	7.04 ± 0.00^{a}	0.60 ± 0.01^{cdefg}	4.14 ± 0.01^{f}	4.32 ± 0.02^{afg}
T7	8.8 ± 0.37^{abcefg}	10.02 ± 0.22^{a}	1.20 ± 0.04^{a}	0.83 ± 0.01^{a}	32.58 ± 0.36^{a}	6.98 ± 0.00^{a}	0.51 ± 0.01^{abcdefg}	3.92 ± 0.01^{beg}	4.38 ± 0.01^{bfg}

T1: control, T2: EM, T3: Agromedia™, T4: IBA, T5: organic fertilizer, T6: peatmoss and T7: seasol. Data are presented in Means ±S.E. Means within the same column of a different line followed by the same letter do not differ significantly according to the posthoc Tukey tests at 0.05.

Conclusion

The type of plant growth media and their added materials influenced the propagation performance of Mas Cotek. It was found that plant cuttings in all treatments successfully grew but with different growth rates. Our findings indicated that Mas Cotek propagated best on rooting media with the combination of 7CC: 3RHB, which provided more economical ways to grow plants and benefit the growers. The effectiveness of rooting was demonstrated to rely on phytohormone, in which the cuttings were handled, and the genetic characteristics of the varieties were investigated. The propagation of Mas Cotek cuttings using this type of plant growth media is one of the most straightforward processes to improve the production of Mas Cotek seedlings. We suggest that further studies should be conducted to investigate other environmental factors, such as the influence of light intensity on the growth performances of Mas Cotek seedlings in BRIS soil.

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