Propagation of valuable tree of eha (Castanopsis buruana Miq.) using stem cutting

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Abstract. Eha (Castanopsis buruana Miq.) is an endemic and valuable species of the Castanopsis genus that can produce wood and the source of food. However, C. buruana has many constraints in its growth and development, such as limited seed production due to the plants are producing seeds very rarely, just one time in every two or three years. Another thing is C. buruana also has low seeds germination because of the hard and thick seeds coat. In order to increase the plant population, it is very important to do species propagation with vegetative propagation methods by using stem cuttings. Therefore, this study aimed to get information about vegetative propagation of C. buruana and determine the success of vegetative propagation C. buruana using stem cuttings influenced by the application of rootone-F. The research was designed using a completely randomized design consisting of 5 (five) treatments, namely no rootone-F (control), rootone F 100 ppm, 200 ppm, 300 ppm, and 400 ppm. Each treatment was repeated 4 (four) times, and each replication consisted of 5 (five) plants so that there was a total of 100 experimental units. The media used was a combination of sand: soil: rice husk charcoal (1: 1: 1 v/v/v). Thus, the variables used to determine C. buruana stem cuttings success were live percentage, sprouting percentage, number of leaves, rooted cuttings, number of roots, length of roots, and rooted days. The data were analyzed using the F test (Analysis of Variance). If the treatments had a significant effect, then it would be followed by the Duncan test with the 95% confidence level. The results showed that the application of rootone F had no significant effect on all tested variables. Nevertheless, the graph trend showed that some variables gave the differences between rootone F treatments and control. At the end of the research, the stem cuttings had not produced roots yet.

1. Introduction
Castanopsis buruana Miq. called eha plant (local name) is an important tree species that belongs to the Fagaceae family. This tree grows in Indonesia, including Southeast Sulawesi, Maluku, Sulawesi, and Kalimantan [1, 2]. The C. buruana tree is one of the 110 important species of the Castanopsis genus in tropical Asia [3]. This species grows naturally in primary and secondary lowland forests up to 1,000 masl with tree heights of approximately 20-30 m and a diameter of 10-30 cm [4]. For the wood strong,
C. buruana is categorized as class II-III and for durability as class III [2] and can be used as buildings and bridges [4].

Another potency, the C. buruana tree, yielded edible seeds used as a food source. Local people made C. buruana for snacks, mixed in their cake and their traditional cuisine. Based on the observations of the proposing team, C. buruana fruits are also consumed by monkeys, birds, and pigs. Castanopsis seeds (Chesnut) contain 66.75% carbohydrates, 2.46% protein and 0.34% fat, and various vitamins [5]. Therefore, C. buruana have high nutritional value [6] and used for the medicinal purpose such as anemia, loss of appetite, preventing abnormalities in the foetus, keeping the balance of nervous system, and as milk alternative for lactose-intolerant persons. So that C. buruana has economically prospective to be developed in the Sulawesi region.

Currently, there has been overexploitation of these plants due to illegal logging activities, mining activities, and expansion of plantations, thus threatening the existence of these plants in natural forests. C. buruana does not produce fruit every year, and their natural regeneration is limited due to poor seed viability and germination. The seeds are easily damaged and have a hard and thick seed coat with a lignin content of 16.61% and 59.78% cellulose, so it takes a long time to germinate [5]. Therefore, vegetative propagation of C. buruana trees is developed using various methods using such as cuttings. Several studies on vegetative propagation on Castanopsis were reported, such as shoot cutting [7] and in vitro propagation on Castanopsis argentea [8, 9]. That is why another cultivation alternative should be done, such as stem cuttings to shorten the growth and the time to flowering. To increase the success of the life of cuttings, using hormones will useful. It can be applied to improve the growth of cuttings. In low concentration, the utilization of growth regulators can trigger cell division and cell expansion and cell structure and as well as function [10]. Therefore this study aimed to assess the success of C. buruana stem cuttings which were influenced by the treatment of rootone-F growth regulators.

2. Methods

2.1. Stem cutting preparation
The experiment was designed using a completely randomized design with five treatments of rootone-F consisting of 0 (control), 100 ppm, 200 ppm, 300 ppm, and 400 ppm. Each treatment was repeated four times, and each replication consisted of 5 (five) plants which means that there were 100 experimental units.

The cuttings were then trimmed from the bases to 25 cm in length and a basal diameter of 8–15 mm. All leaves were removed from the lower third of each cutting. The basal 2 cm of each cutting was treated for 1 sec with treatment for 5 minutes. After auxin treatment, the cuttings were air-dried for 20 min before insertion into a raised greenhouse bench containing a steam pasteurized medium of river sand: soil: rice husk charcoal (1:1:1 v/v/v). After ten weeks, the cuttings were harvested, and various data recorded to include percentage rooting, mean root and number, and length of primary roots = 1 mm. A cutting having one root = 1 mm was considered rooted. Cuttings were maintained and controlled through intermittent water spraying.

2.2. Data analysis
Data were recorded for life percentage, sprouting percentage, number of leaves, number of shoots, number of leaves per shoots, shoots dry weight, percentage of rooting, primary roots, and root length. Data resulted from this study were analyzed using the F test. When the treatments are significantly different, the data were further analyzed using the Duncan test at a 95% significance level to identify which treatments have significant differences. Data analyses were carried out using SAS software version 9.4.

3. Results and discussion

3.1. Results
3.1.1. Life percentage of \textit{C. buruana} stem cuttings. The life percentage of \textit{C. buruana} stem cuttings is presented in figure 1, which showed that the life percentage decreases starting from the third week for the 400 ppm Rootone-F treatment. In the fourth week, the life percentage of \textit{C. buruana} stem cuttings about 93.75% for all treatments, except for the 100 ppm Rootone-F treatment. The life percentage decreased over time.

![Figure 1](image1.png)

**Figure 1.** The survival rate of \textit{C. buruana} stem cuttings.

3.1.2. Sprouting percentage of \textit{C. buruana} stem cuttings. The sprouting percentage of \textit{C. buruana} stem cuttings is presented in figure 2, which shows that 50% sprouting percentage was reached in the 1\textsuperscript{st} week for control, 200 ppm Rootone-F treatment, and 300 ppm Rootone-F treatment. In the 3\textsuperscript{rd} week, the sprouting percentage reached 100% for all treatments, except the 400 ppm Rootone-F treatment (87.5%).

![Figure 2](image2.png)

**Figure 2.** Sprouting percentage of \textit{C. buruana} stem cuttings.

3.1.3. Number of leaves of \textit{C. buruana} stem cuttings. The number of leaves of \textit{C. buruana} stem cuttings is presented in figure 3, which shows that there were no differences among treatments toward the number of leaves of \textit{C. buruana} stem cuttings.
Figure 3. Number of leaves of C. buruana stems cuttings.

3.1.4. The number of shoots of C. buruana stems cuttings. The number of shoots of C. buruana stem cuttings is presented in figure 4, showing no differences among treatments toward the number of shoots of C. buruana stem cuttings.

Figure 4. Number of shoots of C. buruana stems cuttings.

3.1.5. The number of leaves per shoot of C. buruana stems cuttings. The number of leaves per shoot of C. buruana stem cuttings is presented in figure 5 and figure 6, which shows that the average number of leaves per shoot ranges from 1 to 9 leaves per shoot. In the control treatment, the number of leaves per shoot can reach nine leaves.
3.1.6. Shoot dry weight. The shoot dry weight of *C. buruana* stem cuttings is presented in figure 7, showing no differences among treatments toward the shoot dry weight of *C. buruana* stem cuttings. But in figure 7 revealed that the 200 ppm treatment tend to rose slightly shoots dry weight.
3.1.7. Rooting of C. buruana stem cuttings. Until the end of the study, the stem cutting did not produce roots (figure 8).

Figure 8. No-rooting visualization of C. buruana stem cuttings.

3.2. Discussion
Based on data analysis results, the application of rootone-f did not have a significant effect on the percentage of life, sprouting percentage, number of leaves, shoots, leaves per shoot, and shoot dry weight of C. buruana stem cuttings. At the same time, the graphics trend showed that some variables tend to increase the value for using rootone f, but others do not. It could have occurred because the rootone-f hormone that was applied assumed that it did not work optimally because hormone will be effective when given in the right dosage. It was also assumed that nutrient reserves (carbohydrate) stored in the stem are still enough to support the growth of shoots. Thus, there is no significant difference between the control and application of growth regulators. Plants perform photosynthesis and produce photosynthate matter, distributed to all plant tissues and some to be used on cell growth and tissues development and plant organs—the other will be stored as nutrient reserves used in unfavorable environmental conditions. But the trend of some variables such as life percentage, the number of shoots and shoots dry weight on C. buruana stem cuttings (figure 1, 4, and 7) showed that using rootone f hormone produced the grow-up trends. It indicated that rootone f could support leaves and accumulate dry weight even though there is no significant effect. The success of shoots cuttings depends on some external factors like rooting media, temperature, humidity, light intensity, and growth regulator matter. It is also affected by an internal factor such as physiological condition, age of the plant, internal hormone content [11, 12, 13]. According to [14], rootone-F (exogenous auxin) does not affect white Jabon plants and sea bidara [15] due to the adequacy of endogenous auxins.

Cuttings of C. buruana stem showed that until the 12th week of observations, they had not yet seen any root emergence. It was assumed that the stem cuttings taken from coppices stock plants have hard enough plant tissues; thus, hormones given were not sufficient to penetrate the hard tissues of the stem cuttings. So that isn't easy to form roots, or maybe it should take a long time for roots to grow. According to [16], vegetative propagation is usually obtained when the source of the material comes from young tissue compared to adult plants. Auxin hormones are synthesized in young tissue; therefore, they can stimulate root formation. In addition, root formation can be stimulated by several factors, including the sensitivity of cells to auxin, the concentration of root inhibitors at the base of the cuttings, mineral and
carbohydrate content, and the level of lignification or sclerization in the stem. Furthermore, the rooting ability is related to stem anatomy [17, 18], where the low root potential is caused by the formation of lignin and sclerenchyma rings [17]. The cutting material had formed a hard lignin layer and sclerenchyma rings, which will become a mechanical barrier for roots to grow. In line with [19] that cuttings from seedling (juvenile) trees root more readily than cuttings from mature (reproductive) trees. Similarly with [20, 21] also reported that the age of parental plants for material cutting sources also influences the increase in rooting rates. The ability to grow and to develop adventitious roots is dependent on auxin content (endogenous), tissue nutrition, genetics, and age of the parent plant, as well as root media [22, 23, 24, 25]. [22] explained that plants with all-natural essential reserves (root morphogen) and auxins would form roots quickly when cuttings are made and placed in the appropriate environmental conditions.

4. Conclusions
The treatments did not have a significant effect on the growth of cuttings. Nevertheless, the graph trend showed that some variables gave the differences between rootone F treatments and control. At the end of the research, the stem cuttings had not produced roots yet. *C. buruana* could be considered to be propagated using stem cuttings and material sources from juvenile plants.

Acknowledgment
We thank The Southeast Asian Minister of Education Organization Biology Tropical (SEAMEO BIOTROP), Bogor, for project funding through Research Grant 2020.

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