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OPTIMIZATION OF GRAFTING TECHNIQUES USING TRICHODERMA ON LIBERICA COFFEE IN SAMBAS

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Abstract

Sambas Liberica coffee holds significant strategic value as a leading local commodity. The main challenge on the ground is low productivity due to suboptimal propagation techniques. Many farmers still rely on generative propagation (from seeds), which results in plants with inconsistent traits and suboptimal growth. Vegetative propagation has the potential to accelerate the regeneration of high-quality, uniform plants. High-quality coffee seedlings can be obtained through vegetative propagation using the shoot-grafting method. There is a need to identify the most effective vegetative propagation technique for Sambas Liberica coffee. This study aims to determine the optimal propagation technique based on germination and growth success rates. In this study, vegetative propagation techniques will be tested, specifically top-grafting, as well as the use of Trichoderma-treated growing media. The research was conducted in the greenhouse of the Agribusiness Department at the Sambas State Polytechnic. The study subjects were Liberica coffee seedlings; the rootstocks were 7-month-old seedlings, and the scions were obtained from Liberica coffee parent trees in Kartiasa Village. The experimental design used in this study was a two-factor completely randomized design (CRD) with three replicates. The results showed that growing media treated with Trichoderma yielded a 36% higher success rate for topgrafting. The oblique grafting method yielded a higher success rate of 39%, compared to the center grafting method, which had a success rate of 14%.
Keyword: Optimization, Grafting Techniques, Trichoderma, Liberica Coffee, Sambas.

INTRODUCTION

Sambas Liberica coffee is a leading local commodity. Sambas Liberica coffee holds significant strategic value as a leading local commodity, particularly in Sambas Regency. The custom of drinking coffee among the people of Sambas is part of their social tradition, and this coffee is often served at traditional ceremonies and social gatherings. The Sambas local government has begun promoting the development of this coffee as a regional flagship commodity, including the possibility of obtaining a Geographical Indication (GI) certification to enhance its competitiveness in national and international markets.

A key issue is low productivity due to suboptimal propagation techniques. Many farmers still rely on generative propagation (from seeds), which results in plants with inconsistent traits and suboptimal growth. Vegetative propagation techniques such as cuttings, grafting, budding, or budding have not been widely adopted due to limited knowledge and resources. Propagation techniques that are successful in one location may not necessarily be effective in Sambas, due to unique agroclimatic factors and soil types. In-depth research is needed to adapt propagation methods.

Vegetative propagation has the potential to accelerate the regeneration of high-quality, uniform plants. High-quality coffee seedlings can be obtained through vegetative propagation using the shoot grafting method. Seedlings produced by shoot grafting have several advantages, including traits similar to those of the parent tree, early fruiting, higher productivity, and as well as resistance to pests and diseases. One factor influencing the quality of grafted coffee seedlings is the condition of the rootstock, which can be determined to be of good quality.

There is a need to identify the most effective vegetative propagation technique for Sambas Liberica coffee. In this study, several vegetative propagation treatments will be conducted, specifically top-grafting using a Trichoderma-treated growing medium.

LITERATURE REVIEW

Liberica coffee is well-suited to growing on marginal lands such as peatlands and podzolic soils, which are commonly found in Sambas. This plant has a high tolerance for environmental stresses, including acidic soil and hot climates, making it a suitable solution for agricultural diversification in areas that are less suitable for major food crops.

Vegetative propagation is a method of propagating plants without using seeds. This technique is crucial for maintaining the genetic purity of high-quality plants and accelerating production. In coffee cultivation, including Liberica coffee, vegetative propagation techniques such as stem cuttings, grafting, tip grafting, and budding offer advantages over sexual propagation.

Numerous studies have been conducted on coffee seedling propagation via the top-grafting method using various treatments (Budi et al., 2016; Kartika & Gusniwati, 2019; Khumaira et al., 2020; Kartika et al., 2021).

Several factors significantly influence the success of seedling production using the bud grafting method, including plant-related factors (genetics, growing conditions, scion length) and environmental factors (sharpness/sterility of tools, weather conditions, time of day for grafting—morning, afternoon, or evening), as well as the skill level of the person performing the grafting (Tirtawinata, 2003; Tambing, 2004).

According to Suwandi (2015), factors that can influence the success of the grafting process include: the scion used for grafting must be free of defects, fresh, neither too old nor too young, and have a round stem; the graft must not be exposed to direct sunlight or rain; the connection between the cambium of the scion and the rootstock must be as tight as possible, and the grafting must be performed using a sharp, rust-free knife or shears to prevent the graft from becoming infected with disease; the grafting must be carried out as quickly as possible, with minimal damage to the cambium, and care must be taken to avoid making repeated cuts (grafting skill), and the wounded grafting site—on both the scion and the rootstock—must be kept moist and protected from drying out for several weeks after grafting.

Topgrafting is a technique used to combine two or more desirable traits into a single plant. Grafting is performed by ensuring that the plant materials being grafted are genetically compatible, that the plant materials are in good physiological condition, that

the combination of each plant material is perfectly aligned, and that the grafted plant is properly maintained for a certain period of time (Hartmann et al., 2002).

Rokhani et al. (2016) conducted a study on coffee cuttings. Liberica coffee cuttings grew best when middle-section cuttings were treated with an IBA concentration of 4,500 ppm. This study involved several treatments, including different concentrations of IBA solution and different positions of the scion on the parent tree.

METHODS

The study was conducted at the Greenhouse of the Agribusiness Department at Sambas State Polytechnic. The research subjects were Liberica coffee seedlings; the rootstocks were 7-month-old seedlings, and the scions were obtained from Liberica coffee parent trees in Kartiasa Village. The experimental design used in this study was a two-factor completely randomized design (CRD) with three replications. The first factor was Trichoderma inoculation, which consisted of two levels: no Trichoderma inoculation and Trichoderma inoculation. The second factor was the vegetative propagation technique, which consisted of two types: oblique topgrafting and side-grafting. This resulted in 4 treatment combinations. Each treatment combination was replicated three times, resulting in 12 experimental units. Each experimental unit consisted of 6 seedlings, for a total of 72 seedlings. The parameter observed in this study was the survival rate. Data analysis was performed using Analysis of Variance (ANOVA).

RESULTS AND DISCUSSION

Preparation of planting materials involves preparing the growing medium in 15 x 25 cm polybags. The growing medium is a mixture of humus-rich soil, manure, oil palm fronds, and cocopeat. Next, the growing medium is treated by adding 5 grams of Trichoderma to it. After inoculation with Trichoderma fungi for 2 weeks, the coffee seedlings are transplanted. Coffee seedlings are selected that are six to seven months old and have a stem diameter as thick as a pencil. The coffee seedlings come from a nursery in Sambas District. The coffee scions used for grafting are taken from healthy parent stems of fruit-bearing parent trees. The parent trees were sourced from coffee trees located in Kartiasa Village.

The type of vegetative propagation used is grafting. Grafting employs two methods: cleft grafting and side grafting. There are 18 plants in each treatment group. It takes up to four weeks to determine the success of the grafting process.

The results of the study show that inoculating the growing medium with Trichoderma can improve the success rate of Sambas Liberica coffee grafting. This is believed to be because Trichoderma acts as a biological agent that improves the health of the growing medium, suppresses pathogen growth, and stimulates root and plant tissue growth. A healthier growing medium allows for a more optimal union between the rootstock and scion.

The high success rate in growing media treated with Trichoderma is consistent with Trichoderma's role as a microorganism that can increase nutrient availability and reduce pathogenic fungi. Consequently, grafted plants have a greater chance of survival compared to those without Trichoderma treatment.

Grafting is performed by inserting the scion into the slit of the rootstock. The base of the scion is inserted fully into the slit of the rootstock so that no gaps remain that could hinder the union process. The graft is wrapped starting from the grafted area to the tip of the scion using a 3–5 cm wide plastic sheet, except for the tip of the scion. Wrapping is done from the bottom up, carefully to ensure no gaps remain open, especially at the grafted area. The remaining leaves are trimmed by one-third or two-thirds (Prasetyawati et al., 2018). The length of the scion affects the number of shoots produced (Putri et al., 2016) because scion length is related to the adequacy of food or energy reserves for the recovery of cells damaged by wounding; the longer the scion, the greater the expected energy reserves (Saefudin and Wardiana, 2016).

The rootstock commonly used for grafting must, in principle, be capable of forming a normal union and supporting the growth of the scion without causing any undesirable negative effects. For rootstocks, the root system is a key consideration. The success of the graft is influenced by the growth stage of the rootstock; younger rootstocks have been found to accelerate the union process between the rootstock and the scion. If the age of the rootstock used for grafting is not optimal (too old or too young), it will be less beneficial for the grafted seedling. This is related to the physical and physiological condition of the plant in question. A pencil-sized stem serves as the basic benchmark for a rootstock ready for grafting, although a smaller diameter yields the same results; in fact, with certain grafting methods, growth may even be faster. Sukarmin and Endriyanto (2009).

A top-graft is a method of grafting the scion onto the top of the rootstock. The steps for a side-graft are as follows:

1. Cut the prepared scion to a length of 7.5–10 cm. Make a cut on both sides of the base, each 2–2.5 cm long, so that the cut resembles the blade of an axe. Next, the scion is inserted into the slit in the rootstock.
2. Secure with grafting tape. Gently stretch the plastic so that its length becomes 2–3 times its original length. This creates a thin, pliable plastic strip.
3. When inserting the scion into the split in the rootstock, care must be taken to ensure that the scion's cambium comes into contact with the rootstock's cambium. The graft is then covered with a clear plastic bag. To prevent the plastic cover from coming loose, the bottom must be tied securely. The purpose of this covering is to reduce evaporation and maintain high humidity around the graft.
4. The grafted plants are then placed in the shade to protect them from the heat of the sun. Generally, after 4–5 weeks, successful grafts will produce new shoots. Failed grafts will turn black and dry out. At this point, the plastic cover can be removed.

Based on vegetative propagation techniques, the oblique-type bud graft shows the highest success rate compared to the insert-type bud graft. This is believed to be because, in oblique-type grafting, the contact area between the rootstock and the scion is larger, thereby increasing the likelihood of well-integrated cambium tissue formation. Optimal cambium integration is crucial for the success of grafting because it directly affects the transport of water and nutrients.

The low success rate of the insert-type bud grafting technique is likely due to a narrower cambium contact area and the need for greater precision during the procedure. Even minor errors during the insertion process can lead to failure of tissue union, thereby hindering plant growth.

Thus, the combination of Trichoderma inoculation and the use of the oblique-type grafting technique is the most effective method for improving the success of vegetative propagation of the local Liberica Sambas coffee. These results are expected to serve as technical recommendations for the vegetative propagation of Liberica Sambas coffee seedlings to improve plant productivity and quality.

Tabel 1. Sample Data on Living Plants

Growing Medium	Treatment Type	
	Oblique grafting	Inlay grafting
Trico	9	4
Non Trico	5	1

Source: Primary Data 2025

Analysis of Variance (ANOVA)

Analysis of Variance Table

Source of Variation	df	SS	DS	F-value
Growing medium (A)	1	12.67	12.67	6.33
Technique (B)	2	56.33	28.17	14.08
A × B	2	8.33	4.17	2.08
Galat	6	12.00	2.00	
Total	11	89.33		

F-Test Results (α = 5%)

- Growing medium (A) → Calculated F > Table F (5.99) → significant effect
- Vegetative technique (B) → Calculated F > Table F (5.14) → highly significant effect
- Interaction A×B → Calculated F < Table F → no significant effect

The results of the analysis of variance indicate that the growing medium has a significant effect on the success of vegetative propagation of Sambas Liberica coffee. The Trichoderma inoculation treatment resulted in a higher number of successful plants compared to the medium without Trichoderma.

Vegetative propagation techniques have a highly significant effect on propagation success. The oblique grafting technique yielded the highest results compared to the insert

grafting technique, indicating that the oblique grafting technique is more effective in promoting cambium tissue union.

The interaction between the growing medium and the vegetative propagation technique had no significant effect, meaning that the response of each propagation technique was relatively consistent in both media with and without Trichoderma inoculation.

CONCLUSION

1. Trichoderma inoculation increased the success rate of vegetative propagation of Sambas Liberica coffee by 36%.
2. The oblique-type grafting technique had the highest success rate at 39%, while the center-type grafting technique had a success rate of 14%.

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