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Article

The Effect of Soaking Several Types of Auxin on the Growth of Robusta (Coffea Canephora Pierre Ex A. Froehner) and Arabica (Coffea Arabica L.) Cuttings Using Floral Foam Media

Sepdian Luri Asmono[1]*, Bivario Ayubizareta Waskitoi[1] , Dian Galuh Pratita[1], Hatmiyarni Tri Handayani[1]

[1] Program Studi Pengelolaan Perkebunan Kopi, Jurusan Produksi Pertanian, Politeknik Negeri Jember; politeknik@polije.ac.id

* Correspondence: sepdian@polije.ac.id

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Abstract: This study aims to determine the effect of auxin growth regulators, IAA, NAA, and IBA, on the growth of robusta and arabica coffee cuttings in floral foam media. This research was conducted at Jember State Polytechnic and employed a Randomized Group Design (RBD) with two treatment factors. The first factor is three types of Auxin (IAA, NAA, IBA) and the second factor is arabica and robusta coffee types. So there were six treatment combinations and each was repeated five times. This study was conducted for 3 months with the observation parameters were percentage of cuttings survive and growing shoots, shoot emergence time, shoot and leaf length. Data results were analyzed using Analysis of Variance (ANOVA) and Tukey's HSD test at 5% level. Based on the results of the data obtained, it is known that the administration of IBA has the best effect on the parameters of shoot emergence time, shoot length, and leaf length of all types of auxin growth regulator treatments. However, in this study, cuttings grown from several types of auxin applied did not show root formation. The percentage of live cuttings for the treatment of coffee types shows Arabica coffee which is the type of coffee that has the best growth.

Keywords: Auxin, Coffee, Cuttings, Plant Growth Regulators

1. Introduction

Indonesia, which is one of the largest coffee producing countries in the world along with Colombia, Brazil, and Vietnam, has an annual coffee production of 600,000 tons (Sunarharum et al., 2019). The development of coffee area in Indonesia between 1984 and 2022 tends to increase by 0.96% per year (Pusdatin, 2020).Meanwhile, the development of coffee plantation area growth is predicted to continue to increase with an average growth of 1.128% per year (Rahmawati et al., 2024). Therefore, to further optimize coffee plant production, one of the efforts can be made by using superior seeds. One effort to obtain superior seeds is by vegetative propagation through cuttings, so that it can improve the quality and productivity of coffee plants (Ferry, 2015).

Propagation by cuttings is expected to produce new plants that have the same characteristics and properties as their parents. However, the problem is that the success rate of cuttings is relatively low. Therefore, to accelerate the growth of cuttings, it can be done by administering external hormones or growth regulators of the auxin type. Previous research results on micro cutting of Arabica coffee (Filho *et al*., 2018), stated that the use of IBA auxin can increase shoot and root production in Arabica coffee. In addition, IM et al. (2024) also stated that NAA can stimulate the rooting of Robusta coffee cuttings in several compositions of soil, sand, and manure media.

In this study, floral foam media was also used as a substitute for conventional media. Floral foam is generally known as a medium that is able to retain water well and supports high humidity, so it is expected to help maintain the humidity of the cuttings during the rooting process.So the purpose of this study was to determine the effect of administering growth regulators auxin IAA (Indole-3-Acetic Acid), NAA (Naphthaleneacetic acid), and IBA (Indole-3-Butyric Acid) on the growth of robusta and arabica coffee cuttings on floral foam media.

2. Materials and Methods

This research was conducted in March to May 2024 at the Field Laboratory, Politeknik Negeri Jember, Jember Regency, East Java. The tools and materials used include pruning shears, measuring cups, rulers, robusta coffee scions, arabica coffee scions, IAA, NAA, IBA auxins, distilled water, floral foam, seedling trays, plastic seed covers. The planting medium used floral foam measuring 3 cm x 3 cm which was then given water to make it feel moist, and placed in a seedling pot/small bucket according to the size of the floral foam. The filled containers were then arranged based on the predetermined randomization.

The cuttings used robusta coffee scions clone BP 409 and Arabica coffee varieties of Lini S 795 which were 4-5 months old by cutting 1 segment each with a length of 8 cm and leaving the tip of the leaf, All cuts were made with sterilized pruning shears. Auxin concentration in this treatment, Robusta and Arabica coffee cuttings were soaked in an auxin solution according to a concentration of 100 ppm with a soaking time of 2 hours. After being given the next treatment, the cuttings were planted by planting the cuttings in the foam media at a depth of 3 cm.

This study was conducted using a Randomized Block Design (RBD) with 2 treatment factors used. The first factor was IAA, NAA and IBA soaking, each with a concentration of 100 ppm. And the second factor is the type of Robusta and Arabica coffee. There are 8 treatment combinations and each treatment will be repeated 4 times. In each replication there will be 4 plants, so that the number of treatment units is 32 and the number of plants to be cut is 128 plants.

The parameters observed were: 1) Percentage of cuttings survive and growing shoots by calculating the number of living cuttings and successfully growing shoots from each treatment and expressed in percent; 2) The time of emergence of shoots carried out every day for 3 months is done by counting the cuttings that appear and grow shoots every day; 3) Length of shoots and length of leaves. The length of coffee cutting shoots is measured from the bottom base to the highest growing point using a ruler. This measurement is carried out at the age of 14 days after planting. While the measurement of leaf length is carried out using a ruler in centimeters. Leaves are measured that grow in each replication, measurements are taken from the base to the tip of the leaf. Measurement of leaf length is carried out at the age of 14 days after planting.

3. Results and Discussion

3.1. Cuttings Survive Percentage, Shoot Growth Percentage and Shoot Emergence Time

Based on the results of the ANOVA test, Arabica coffee has a higher survival rate compared to Robusta coffee in cutting conditions using floral foam, as in Table 1.

Table 1. Percentage of fresh cuttings and successful shoot growth in several types of coffee

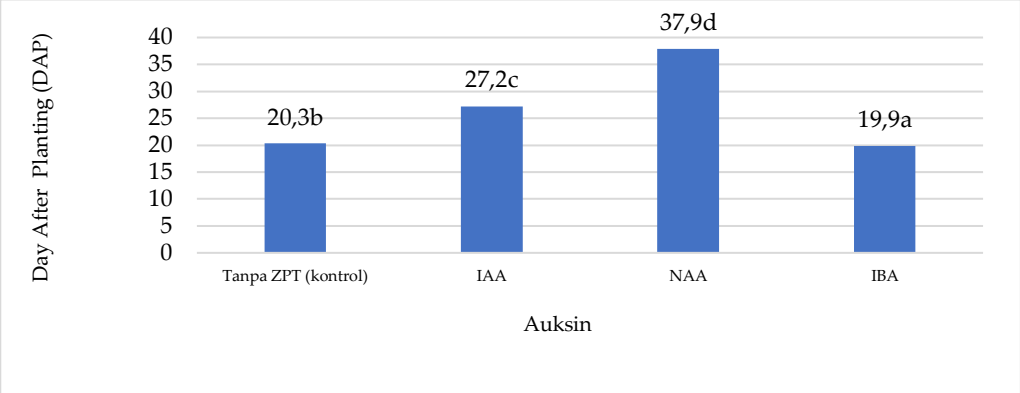
Type of coffee	Cuttings Survive Percentage	Shoot Growth Percentage
Robusta	45,3% [a]	100%
Arabika	67,2% [b]	100%

Note: Tukey's HSD test results use a 5% level. Different notation letters indicate very significant different results.

Observation of the percentage of cuttings that still survive was carried out at the end of the study or at the age of 12 MST. Living cuttings are marked by fresh green coffee scions. Table 1 shows that the percentage of living cuttings of robusta coffee is 45.3%. Meanwhile, Arabica coffee has the highest success rate of living cuttings, which is 67.2%. Puspita (2021) argues that the percentage of plant life is influenced by factors in the plant such as food reserves, water supply, endogenous hormones, the environment (such as temperature, media humidity and shade), implementation of media making techniques, cutting cuttings and plant maintenance all affect the success of cuttings.

The percentage of cuttings growing shoots shows that the success of cuttings growing shoots has a 100% success rate in all treatment combinations. The provision of plant growth regulators from outside the plant to the cuttings is carried out to stimulate the formation of roots and shoots. Providing the right concentration of auxin will stimulate the growth of plant explants, especially the formation of leaves, shoots and internodes. Auxin functions as cell elongation, cell enlargement, callus formation and root formation (Asmono, 2023). The success of the percentage of cuttings growing shoots may be due to the fact that the process of plant cell elongation is greatly influenced by the auxin hormone, both those synthesized directly by the plant itself (endogenous) and those given to the plant in the form of growth regulators (exogenous). Auxin absorbed by plant tissue activates food reserve energy, increases cell division, cell elongation and cell differentiation, which ultimately forms the process of shoot elongation (Astutik, 2021).

The time of emergence of shoots showed very different results in the treatment of several types of auxin, as in Figure 1 below:



Note: Tukey's HSD test results use a 5% level. Different notation letters indicate very significant different results.

Figure 1. The emergence of shoots from several types of Auxin.

The results of observations on the emergence of shoots showed varying results between several types of auxins used. The fastest emergence of shoots from robusta and arabica coffee cuttings was seen in the IBA treatment, namely at 19.9 DAP. Meanwhile, NAA applied to robusta and arabica coffee cuttings had the slowest growth rate compared to other types of auxins. The rate of shoot growth when NAA was given to coffee cuttings averaged 37.9 DAP. The IBA hormone is often used as a trigger for plant rooting because it is more active. This is in accordance with the observation that IBA hormone treatment is able to stimulate and increase the percentage of living cuttings compared to NAA hormone treatment (Astutik, 2021). Because IBA has relatively stable chemical properties and mobility in the plant body, with a long-term effect function and remains near the application location without affecting other growth, producing fertile roots with a normal structure, while IAA can spread to shoots, this can inhibit the development and growth of shoots. NAA has a narrow concentration range, while IBA has a more flexible concentration range (Chairul, 2021).

3.2. Shoot and Leaf Length

Based on the results of the ANOVA analysis, several types of auxin showed very significant differences in the parameters of shoot and leaf length at 90 DAP. The results of the analysis can be seen in Table 2 below:

Table. 2. Shoot Length and Leaf Length of Robusta and Arabica Coffee Cuttings at 90 DAP

Type of Auxin	Shoot Length (cm)	Leaf Length (cm)
Control	1,3 ^{ab}	1,9 ^{b}
IAA	0,5 ^{a}	1,6 ^{a}
NAA	3,2 ^{c}	1,6 ^{ab}
IBA	3,4 ^{c}	2,4 ^{b}

Note: Tukey's HSD test results use a 5% level. Different notation letters indicate very significant different results.

In the last observation when the cuttings were 90 DAP the highest shoots were found in the IBA type of growth regulator with an average leaf length of 3.4 cm. IBA also produces the longest leaves with an average of 2.4 cm. The growth of shoot and leaf length is greatly influenced by several factors, for example the presence of hormones in the auxin growth regulator used. Auxin affects the process of cell elongation, cell division, and differentiation of plant cells, stimulates cambium activity and the formation of phloem and xylem vessels. Therefore, growth regulators are needed to stimulate the growth of shoots with the auxin which will spur the growth of new cells which can increase the length of the shoots. Alfin (2016) argues that the content of food in cuttings and plant growth, especially protein, carbohydrates, and nitrogen, greatly affects the growth and development of plant roots and shoots.

4. Conclusions

Based on the results of the study, it can be concluded that the growth regulator auxin IBA has the best effect on the parameters of shoot emergence time, shoot length, and leaf length. But, cuttings grown from several types of auxin applied did not show root formation. In the percentage of live cuttings, the type of treatment shows that Arabica coffee is the type of coffee that grows best from the Robusta coffee type.

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