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## **The Effect of Auxin and Cytokinin Hormones on the Growth of Robusta Coffee (*Coffea Canephora*) Seedlings in the Grafting Propagation Method of Plagiotrop Rootstock Cuttings**

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### **ABSTRACT**

**KEYWORDS:**

*Auxin,*  
*Cytokinin,*  
*Robusta Coffee,*  
*Vegetatif Propagation.*

Robusta coffee is a type of coffee that can be cultivated vegetatively. Grafting cuttings technique is one of the propagation techniques commonly used in Indonesia. The use of auxin and cytokinin hormones can be used in the coffee seedling phase to support the growth of coffee plants. The purpose of this study was to determine the effect of auxin and cytokinin hormones on the growth of robusta coffee seedling in the cuttings grafting method. The method use was a factorial completely randomized design with 2 factors. Factor 1 is the concentration of auxin hormones consisting of 3 levels, namely A<sub>1</sub> (0 ppm), A<sub>2</sub> (50 ppm), and A<sub>3</sub> (100 ppm). Factor 2 concentration of cytokinin hormone which consists of 3 levels namely S<sub>1</sub> (0 ppm), S<sub>2</sub> (50 ppm), and S<sub>3</sub> (100 ppm). The result were analysed using ANOVA and further test using Duncan Multiple Range Test (DMRT). The parameters observed were the percentage of cuttings success, number of leaves, number of shoots, shoot height, shoot diameter, chlorophyll content. The result showed that the provision of 50 ppm auxin and 50 ppm cytokinin had the best trend in the variable number of leaves, shoot diameter and shoot height.

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## **1. INTRODUCTION**

Robusta coffee is a type of coffee that is widely cultivated in Indonesia. Based on the aspect of cultivation, coffee commodities are dominated by smallholder plantations of more than 90% while the remaining less than 10% comes from private or state plantations (Rahardjo, 2021). In 2020 coffee production amounted to 762,38 thousand tonnes rising to 786,19 thousand tonnes in 2021 or an increase of 3,12 percent, and in 2022 coffee production fell to 774,96 thousand tonnes or a decrease of 1,43 percent (Statistik Kopi Indonesia, 2021). Factors causing the decline in coffee production include the age of coffee trees exceeding productive age, the spacing of coffee trees that are not in accordance with the provisions of the Ministry of Agriculture, and the use of inputs in the form of coffee trees that are still hereditary from the 1980s (Septiani & Kawuryan, 2021). One way to increase the production of coffee cultivation is to use superior planting material (Pujaningrum & Simanjuntak, 2020).

Robusta coffee seedlings cannot be propagated generatively because Robusta coffee is cross-pollinated, so the provision of Robusta coffee seedlings must be done clonally or vegetatively, one of which is by grafting cuttings. Grafting cuttings is relatively faster than grafting cuttings, because the root initiation process in the cutting process coincides with the recovery process of the grafting

process (Irlando, 2020). However, because of this, optimal conditions are needed to support the growth of coffee seedlings during the nursery period so that the growth of coffee seedlings is not hampered.

According to Irlando (2020), growth stimulating substances are also called hormones that are indispensable for plants, especially in the seedling phase. Growth hormones can also be used to stimulate root growth to grow more, larger root volume, and sturdier so that coffee plants will not collapse easily. Auxin is one of the plant hormones that can regulate many physiological processes such as growth, cell division, cell differentiation, and protein synthesis (Tamba et al., 2019). Auxin is a growth hormone whose activation in tissues is related to the balance between synthesis and loss of auxin due to transport and metabolism (Rodyady et al., 2024). Meanwhile, cytokinins are adenine-derived compounds and play a role in the regulation of cell division and morphogenesis. Cytokinins are used to stimulate the formation of buds, influence cell metabolism, and stimulate dormant cells and their main activity is to encourage cell division (Karjadi and Buchory, 2008). The purpose of this study was to determine the effect of auxin and cytokinin hormones on the growth of robusta coffee seedlings in the grafting method.

## 2. MATERIALS AND METHODS

This study was conducted in January – June 2024 in Jenggawah sub-district, Jember, East Java. the planting material used was clone BP 308 as rootstock and BP 939 as entres. The preparation of entries for grafting was carried out by practitioners who are accustomed to grafting with a high percentage of success. The preparation of entries for grafting was carried out by practitioners who were accustomed to grafting with a high percentage of success, thus reducing human error in each experimental unit. The spliced planting material will then be planted on the planting media that has been provided.

After completing the process of making a 100 ppm stock solution of auxin and cytokinin hormones, then the stock solution is stored in a closed bottle. Next, the application is carried out on the seedlings of robusta coffee cuttings by spraying as much as 20 ml for each plant using a sprayer. the application is given foliarly at the bottom of the leaves with an application interval of 2 weeks once for 2 months.

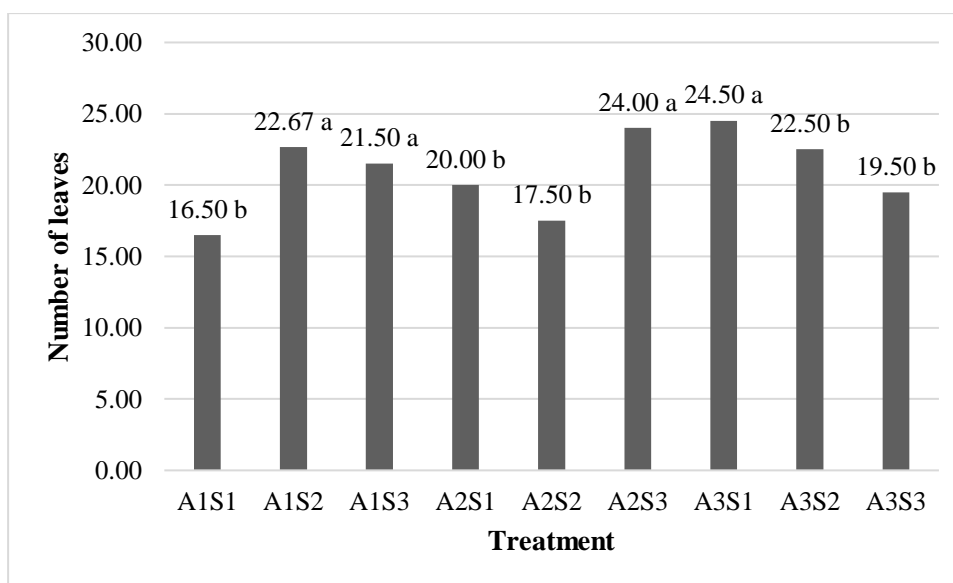
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## 3. RESULTS AND DISCUSSION

The results of observations on the percentage of success of cuttings show that the grafting of cuttings carried out is 100% successful, marked by no dead or withered coffee plants. This is because the process of grafting cuttings is carried out by practitioners who are experienced in grafting cuttings. thus minimising failure in the process of grafting cuttings. Coffee propagation by grafting cuttings is done by connecting the entres with the rootstock first, then at about the same time the bottom of the rootstock is cut diagonally and then planted in polybags (Tanwir, 2018).

The treatment of 100 ppm auxin and 0 ppm stockinine showed the highest average value (24.50 leaves). The interaction of auxin and cytokinin hormones in affecting the number of leaves of cuttings grafted seedlings is due to the formation of leaves determined by the number and size of cells in the plant. Auxin can develop cell size by affecting osmotic pressure (Sa'adah et al.,

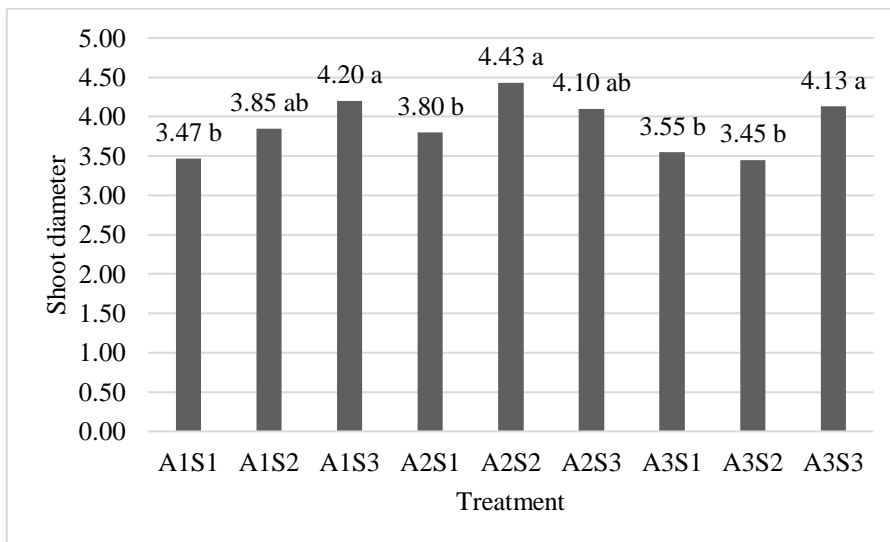
2021). The increase in water absorption is caused by the softening of the cell wall due to the action of auxin. This eventually causes the cell to expand. Auxin will increase plant growth by affecting the plasma flow of cells and making nutrient absorption more effective. Exogenous auxin hormone application will help activate the endogenous auxin hormone in the plant so that leaf formation can take place better. Plants that are given the application of the hormone auxin will give a rapid growth response, especially in the number of leaves because the hormone auxin plays a role in plant cell division.



**Figure 1. Number of leaves, Means followed by the same letter show no significant difference in the DMRT test at the 5% level**

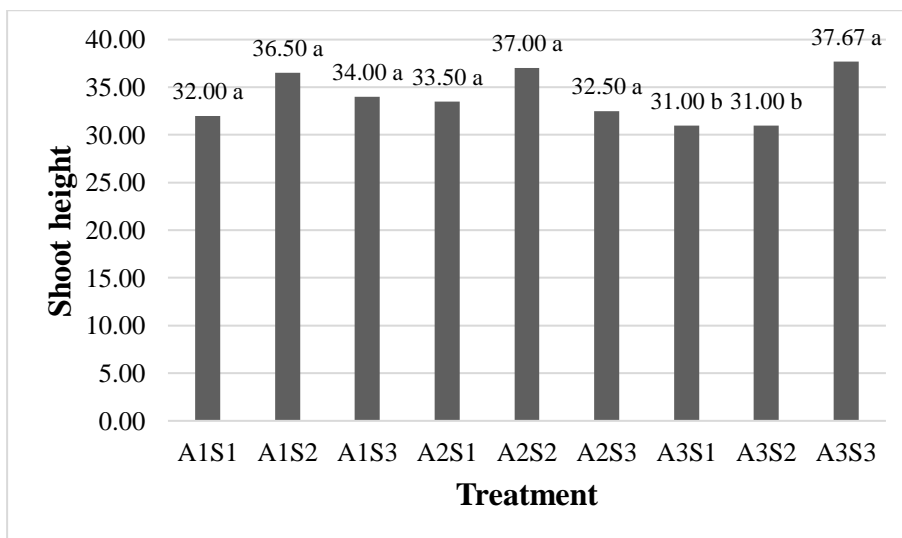
Observations of stem diameter were made by measuring the increase in diameter length (mm) of the upper stem. this is because, in the process of grafting cuttings that are expected to grow and develop is the upper stem. so, if a branch grows at the bottom of the stem, the branch is immediately cut to ensure the growth of the desired shoot. The results showed that the treatment combination 50 ppm auxin hormone treatment and 50 ppm cytokinin ( $A_2S_2$ ) gave the best results with an average value of 4.43 mm (Figure 2).

Exogenous hormones given to plants will help the work of auxins in plants. Auxin is used for cell division and root differentiation. Cytokinin is a growth regulator that is used to stimulate adventitious budding (Yusnita, 2003). Auxin can spur the development of vessel tissue and encourage cell division in the cambium of the vessel so as to support the growth of stem diameter. Auxin hormones and cytokinin hormones that work together in the process of growth of cells in the cambium or often referred to as secondary growth are very influential on shoot diameter parameters (Arimarsetiowati and Ardiyani (2012). the results of observations on the shoot diameter parameter showed significantly different results. the highest results were obtained from a combination of 50 ppm auxin hormone treatment and 50 ppm cytokinin.



**Figure 2. Shoot diameter, Means followed by the same letter show no significant difference in the DMRT test at the 5% level**

In plants there is a process of cell elongation is strongly influenced by the hormone auxin either synthesised by the plant itself (endogen) or given to the plant in the form of growth regulators (exogen) (Novianti, 2015). Plants that have undergone the absorption process of auxin and cytokinin will work together to activate food reserve energy and increase cell division, cell elongation, and cell differentiation which ultimately forms the shoot elongation process. One of the functions of cytokinin in plant growth is to assist meristem tissues in the formation of buds (Lukikariati, 1996). Cytokinin plays a role in regulating cell enlargement, organ formation, and the development of shoots and bud eyes (Harjadi 2009). The observation results showed that there was a significant difference based on the height of the shoots (Figure 3) from the treatment of auxin and cytokinin hormones. From these data, it was obtained that the treatment combination of auxin 50 ppm and cytokinin 50 ppm (A<sub>2</sub>S<sub>2</sub>) showed optimal results and was also efficient and because the results of this study were in accordance with (Rosyady et al.,2023) that, the application of IAA with a concentration of 50 ppm increased the growth shoot length. This is because the process of shoot height growth in plants is influenced by auxins that can stimulate shoot formation in plants and cytokinins play a role in stimulating the growth of adventitious shoots.



**Figure 3. Shoot height, Means followed by the same letter show no significant difference in the DMRT test at the 5% level.**

#### 4. CONCLUSIONS

The results showed that the treatment of 50 ppm auxin and 50 ppm cytokinin gave the best number of shoots and shoot height. while the administration of 100 ppm auxin and 0 ppm cytokinin gave the best results on the variable number of leaves.

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