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The Effect of Giving PGRs Rootone F on Cacao Cuttings (Theobroma Cacao. L) Wrapped in Molding Soil

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Abstract

Propagation by cuttings often experiences obstacles in root and shoot growth, because endogenous auxin in stem cuttings is in a concentration that is unable to affect root formation. One way to increase the role of auxin and encourage root growth is by administering plant growth regulators (PGRs) Rootone-F with the ends of the cuttings wrapped in molded soil. The study aims to study the effect of various PGRs concentrations on the growth of cacao plant cuttings wrapped in molded soil. The study was conducted in an experimental garden located in Batang Hari Regency, Jambi. The design used in this study used a Completely Randomized Design with one factor, the administration of PGRs Rootone-F with the tip of the cutting wrapped in mold soil with treatment levels R0 = 1 g Rootone-F, R1 = 1 g Rootone-F + Water 1cc cuttings^{-1}, R2 = 1 g Rootone-F + Water 2cc cuttings^{-1}, R3 = 1 g Rootone-F + Water 3cc cuttings^{-1}, R4 = 1 g Rootone-F + Water 4cc cuttings^{-1}. Observations; percentage of living cuttings, shoot length, number of leaves, number of primary roots. Data were analyzed statistically using analysis of variance, if the analysis of variance showed a significant effect, continued with the DNMRT test at the α level of 5%. Results of the study: The treatment of Rootone-F dosage gave a very significant effect on the percentage of living cuttings, shoot length, number of roots, number of leaves and root dry weight. Dosage 1 g Rootone-F + Water 4cc cuttings^{-1} showed better results than others.

Keywords: Cacao Cuttings, PGRs Rootone-F, Molded Soil

Introduction

Cacao plants (Theobroma cacao. L) are plantation crops that generally grow in tropical areas. The part of the cocoa fruit that is used is the seed, which is then processed in such a way as to produce cocoa powder, commonly used as a refreshing drink and snack. Cacao development in Indonesia, which is dominated by smallholder plantations, is currently experiencing an attack of fruit rot disease, therefore the utilization and planting of Cacao that has good resistance, high production and good quality is very much needed (Rosmawati *et al*., 2015) [15]. The development of Cacao production in Indonesia shows that smallholder plantations in recent years have been the most dominant, with a production share of around 50.47%. Meanwhile, the distribution of large state plantations and private plantations is 37.30% and 12.23% respectively. The increase in production by state plantations is relatively stable. Indonesian cocoa has experienced quite rapid development (Directorate General of Plantations, 2021) [1].

According to Siregar, Slamet, Nuraeni (2014) [17]. Indonesian Cacao production comes from large state and private plantations located in North Sumatra and East Java. In addition, it also comes from people's plantations spread across the regions of Maluku, South Sulawesi, East Kalimantan, and Papua. The increase in business in the field of Cacao cultivation has increased foreign exchange for the country through exports and boosted the regional economy, especially in rural areas. For this reason, the government prioritizes Cacao production as one of the commodities that is being developed rapidly.

Meanwhile, compared to Cacao productivity in Jambi Province, it fluctuates every year and tends to decline. The decline in cocoa productivity is closely related to the implementation of simple cultivation techniques, the varieties used and climate conditions. One way to overcome this is to improve the cultivation methods of the plants themselves, such as providing quality seeds (Jambi Province Plantation Service, 2021) [1]. The development of Cacao plants in Jambi province from 2017-2021 has seen an increase in the area, production and productivity of Cacao plants, as can be seen in Table 1.

Table 1: Area and productivity of cocoa cacao plants in Jambi province in 2017-2021

Year	Area (Ha)	Production(Ton)	Productivity (kg/Ha)
2017	2439	595	585
2018	2617	822	575
2019	2681	826	569
2020	2702	845	540
2021	2929	887	504

Source: Directorate General of Plantations (2021)

Cocoa plants can be propagated by seeds (generative) and by cuttings (vegetative). Cuttings are a method of artificial vegetative plant propagation by using part of the stem, roots, or leaves of the plant to grow into new plants. As an alternative to artificial vegetative propagation, cuttings are more economical, easier, do not require special skills and are faster compared to other artificial vegetative propagation methods. Propagation by cuttings will be less profitable if it encounters conditions where the plant is difficult to root, newly formed roots cannot withstand environmental stress and the plagiotropic nature of the plant still persists (Surwato and Yuke, 2004) [18].

Seedlings originating from cuttings have the same genetic characteristics as their parents. Thus, high production or other good characteristics can be obtained if the cuttings planting material comes from selected trees. The success of propagation by cuttings is marked by the occurrence of root and shoot regeneration in the cutting material so that it becomes a new plant. Root and shoot regeneration is influenced by internal factors, namely the plant itself and external factors or the environment. One of the internal factors that influences root and shoot regeneration is phytohormones which function as growth regulators (Siregar, Slamet and Nuraeni, 2014) [17].

Given the importance of the role of roots in determining the success of cuttings, it is necessary to make efforts to stimulate and accelerate the root growth process. One way is by providing PGRs (Plant Growth Regulators) to help the rooting process. The use of Plant Growth Regulators aims to stimulate root formation. The roots produced are usually more than without the provision of growth regulators (Putri, Dyan and Sudianta, 2009) [13].

According to Fridiya and Sitawati (2020) [2] the Rootone-F substance is used as a root growth stimulant to encourage root formation such as in cuttings, grafts, and stumps. The role of this growth regulator is to suppress death in cuttings. Furthermore, Siregar, Slamet and Nuraeni (2014) [17] there are quite a lot of growth regulators circulating on the market and one of them is Rootone-F which in its packaging contains synthetic auxins, namely Indole Butyric Acid (IBA) and Naphtalene Acetic Acid (NAA) which are substances that stimulate root growth in plants by dipping or soaking for 5 minutes.

According to Payung and Susilawati (2014) [11] Rootone-F is useful for accelerating and increasing the emergence of new roots because it contains active ingredients similar to auxins from the formulation of several root growth hormones, namely IBA and NAA. IBA and NAA growth regulators are effective synthetic auxins that are commonly used to encourage rooting of cuttings. Furthermore, it is also explained that at a concentration of 500 ppm Rotoone-F PGRs, the percentage of survival of tembesu stem cuttings increases by 80%. The results of research by Mulyani and Ismail (2015) [7] showed that giving Rootone-F at a concentration of 200 mg liter^{-1} provided plant growth in shoot length and number of water apple leaves. In the treatment of Rootone-F at a concentration of 300 ppm, the best growth was in root length, number of roots and weight of water apple roots. The research results of Putra, Indriyanto and Melya (2014) [2] showed that administering Rootone-F with a concentration of 200 mg liter^{-1} of water with soaking for one hour resulted in increased shoot height, root length and number of leaves on jabon shoot cuttings.

The technology uses a method of molded soil as a bandage or cover for the bottom of the cuttings after being given PGRs Rootone-F and before being planted in the media that has been provided, can maintain the humidity and homogeneity of the PGRs to the cuttings. The use of molded soil so that the solution sticks to the cuttings does not spread during watering and the position of the cuttings becomes sturdy, does not fall easily during watering, reduces water evaporation, and binds PGRs so that it is not easily broken down. Molded soil uses soil with a high percentage of clay fraction because it contains a lot of minerals, water, air, and organic matter. Molded soil is clay with a composition of topsoil and water with a ratio of 2:1 (Kurniati, 2013) [5].

Materials and Methods

This research was conducted at the Research was conducted at the Jambi Horticulture Main Seed Center (BBI) Muaro Jambi Regency in Indonesia. The materials used in this study include cacao stem cuttings, Plant Growth Regulators (Rootone-F), ultisol soil, sand media, plastic covers, paranet, bamboo. The tools used were cutting scissors, hoes, sieves, watering cans, 1.5 inch PVC pipes 7 cm long (for soil molding), thermohygrometers, manual scales and electric scales, buckets, meters, knives, electric openers, stationery, polybags, and rapia ropes.

The design used in this study used a Completely Randomized Design (CRD) with one factor, giving Rootone-F PGRs with cuttings wrapped in molding soil with treatment levels R0 = 1 g Rootone-F cuttings^{-1}, R1 = 1 g Rootone-F + Water 1cc cuttings^{-1}, R2 = 1 g Rootone-F + Water 2cc cuttings^{-1}, R3 = 1 g Rootone-F + Water 3cc cuttings^{-1}, R4 = 1 g Rootone-F + Water 4cc cuttings^{-1}. Each experimental unit consisted of 20 units of plant cuttings, so that the cacao cuttings needed in this experiment amounted to 400 cacao plant cuttings.

Observation; percentage of live cuttings (%), shoot length (cm), number of leaves, number of primary roots. Data were analyzed statistically using analysis of variance, if the analysis of variance showed a significant effect, it was continued with the DNMRT test at the α level of 5%.

Results and Discussion

The results of data analysis from observations of the growth of cacao plant cuttings given Rootone-F and wrapped in molding soil are shown in Table 2 below:

Table 2: Average Value of Cacao Plant Cutting Growth Observations

Treatment Rootone-F	Percentage of Live Cuttings (%)	Shoot Length (cm)	Number of Leaves	Number of Primary Roots
R0	10.50a	0.57a	1.09a	0.71a
R1	12.75b	1.12a	1.00a	0.71a
R2	14.00b	4.86b	1.70b	1.79b
R3	16.25c	13.63c	1.99b	2.24c
R4	16.75c	29.50d	2.72c	2.55d

Description: Numbers followed by the same lower case letter are not significantly different in the DNMRT follow-up test at the 5% level.

Based on the results of the analysis of variance on the dry weight of cacao plants, it shows that the administration of Rootone-F has no significant effect on the dry weight of cacao plants. While on the percentage of living cuttings, shoot length, number of leaves, number of primary roots shows that the administration of Rootone-F has a significant effect. Further DNMRT tests at the 5% level for each treatment can be seen in Table 2.

The results of the analysis of the administration of PGRs Rootone-F on the percentage of living cuttings show that the administration of 1 g Rootone-F + 4cc Water cuttings^{-1} (R4) shows the highest percentage of living cuttings, namely 16.75%. Statistically, the R4 treatment shows a significant difference with all treatment levels except for the R3 treatment which is not significantly different. The R0 treatment gives the lowest percentage of life and is significantly different from all treatment levels. Shoot growth on plant cuttings with a dose of (R4) 1 g Rootone-F + 4cc Water cuttings^{-1} shows the longest shoot length of 29.50 cm and is significantly different from all other treatments. The number of leaves on plant cuttings with a dose of (R4) 1 g Rootone-F + Water 4cc cuttings^{-1} showed the highest number of leaves, which was 2.72 and was significantly different from other treatments. The number of roots on plant cuttings with a dose of (R4) 1 gram Rootone-F + Water 4cc cuttings^{-1} showed the highest number of roots, which was 2.55 and was significantly different from other treatments.

The results of the analysis of the percentage of living cuttings, shoot length, number of roots, number of leaves and dry weight of roots in the treatment of giving PGRs Rootone-F gave a very significant effect. It is suspected that this effect is caused by Rootone-F which is given to the cuttings wrapped in molding soil (the molding soil functions so that the hormone is not easily broken down from the base of the cuttings, and functions to maintain humidity). Basically, growth is the result of metabolic activity not only providing raw materials for growth but also providing energy for all processes that occur in the plant body. Plant growth is indicated by an increase in size and dry weight that cannot be reversed. This growth reflects the increase in protoplasm that occurs because the size and number increase. Puspitorini (2016) [14] explained that Rootone-F is a synthetic growth regulator that has active ingredients combined from IBA and NAA which are very active in stimulating the sprouting and growth of cutting roots.

Giving 1 gram of Rootone-F + 4cc of water to cuttings^{-1} gave the highest results for the percentage of living cuttings, shoot length, number of roots, number of leaves and dry weight of roots. This is because at a dose of 1 g Rootone-F + 4cc Water cuttings^{-1} auxin can be absorbed by the cuttings more and is able to encourage faster callus formation at the base of the cuttings. Callus that is formed quickly will prevent the base of the cuttings from rotting because callus functions as a wound cover. Callus formation followed by root formation on cuttings is an auxin activity, the roots that are formed will reduce the number of deaths in cuttings. According to Mulyani (2015) [7] the growth regulator Rootone-F which is a synthetic auxin at too high a dose tends to inhibit cutting growth and cause cuttings to fail to root. Rootone-F used is a synthetic growth regulator from a combination of Indole Butyric Acid (IBA) and Naphtalene Acetic Acid (NAA) which functions as a cell division stimulus, thus allowing the formation of a better root system in cuttings treatment and increasing cutting growth.

In the R0 (control) treatment, the percentage of live cuttings, shoot length, number of roots, number of leaves and dry root weight were given. This is thought to be because in the R0 (control) treatment there was no addition of auxin so that endogenous auxin in the cuttings was lacking to encourage, stimulate root growth, and cocoa cutting shoots when compared to cuttings given Rootone-F. According to Nurlaeni and Surya (2015) [8], root formation is the most important factor in encouraging the success and life of cuttings because the roots will absorb the nutrients in the soil for growth and cutting needs.

Auxin contained in Rootone-F can activate proteins and enzymes and will stimulate the shoots to grow faster. Auxin helps flow cytoplasm and activate metabolic processes in plant cells so that it can affect plant growth and development. Auxin can increase the formation of proteins and the production of enzymes that stimulate shoot growth by the shoots synthesizing IAA (Olatunji, Geelen, and Verstraeten, 2017) [10].

Fendrych, Akhmanova, and Merrin (2018) [3] stated that the concentration of Plant Growth Regulators that is too low will result in a long rooting time while the concentration is too high causes the possibility of cuttings not forming roots but only callus. Furthermore, Untari and Puspitaningtyas (2006) [16] explained that the concentration and amount of this hormone are highly dependent on factors such as the age of the cutting material, the time and duration of hormone administration, the method of hormone administration, the type of plant and the cutting system used. The older the age of the cutting material, the higher the hormone concentration required, the more wood fiber in the stem, the longer the time required for hormone administration and vice versa.

The formation of leaves on cuttings is highly dependent on temperature and humidity conditions. The water needed for leaf growth on cuttings is the water that sticks to the cuttings. According to Ofodile, Chima, and Udo (2013) [9] cuttings have limitations, including those related to water, cuttings are only in the form of pieces of the parent tree which are limited in size so that they have limited water reserves. To suppress excessive evaporation of water out of the cuttings, it can be prevented by increasing the humidity of the cutting environment. According to Huik (2004) [4] Rootone-F is active in accelerating root growth so that the absorption of water and nutrients will be high and balance the evaporation of water in the parts of the plant above the ground.

Giving 1 g Rootone-F + Water 4cc cuttings^{-1} is a sufficient dose to increase growth and increase the dry weight of cocoa plants. Fulfilled plant nutrient needs will cause the rate of division, cell elongation and tissue formation to run quickly so that the dry weight of the plant increases. According to Marfirani, Rahayu and Ratnasari (2014) [6], plant growth is indicated by the increase in dry weight size which reflects the increase in protoplasm because the size and number of cells increase. To obtain optimal plant growth, it requires the administration of Rootone-F with the right dose and method of administration. If Rootone-F liquid is given directly by soaking it is better for plant growth. If

Rootone-F is given by or paste, the plant will experience slowness and fail to root and cause wilting.

Conclusion

The treatment of Rootone-F dosage on cacao plant cuttings wrapped in molding soil has a very significant effect on the percentage of living cuttings, shoot length, number of primary roots, number of leaves and root dry weight. Administration of Rootone-F with a concentration of 1 g Rootone-F + 4cc Water cuttings^{-1} (R4) can produce a percentage of living cuttings of 16.57%, shoot length 29.50cm, number of leaves 2.72 and number of primary roots 2.55.

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