



PERCENTAGE OF SUCCESSFUL CUTTINGS OF RED STAR BEGONIA PLANTS ON THE USE OF CUTTINGS MATERIAL AND ROOTZONE F

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Abstract

Begonia is an ornamental plant in demand among the public because of its attractive leaf shape. With this, the needs of ornamental plants need to be met. One of them is by doing plant propagation. Plant propagation can be done vegetatively, namely with leaves. The weakness is that the cutting material quickly dries, rots, and dies. It can be overcome by using ZPT (Growth regulator).

This research aims to determine the percentage of success of the best cuttings of begonia plants in the combination treatment of cuttings material and several concentrations of Rootone F. The research used a planting model in germination tanks with 25 cuttings. The factors used in the study were cutting material (sliced leaves, whole leaves) and Rootone F concentration (250 ppm, 300 ppm, 350 ppm, 400 ppm) soaked for 30 minutes. Observations were made seven weeks after planting. The research showed that the best combination treatment was whole leaf cuttings and 400 ppm concentration, with the highest percentage of rooted cuttings at 92%, rooted cuttings at 80%, and live cuttings at 80%.

Keywords: Leaf Cuttings, Rootone F and Percentage of Success

INTRODUCTION

Ornamental plant development is one of Indonesia's most rapid developments. Indonesians are interested in collecting ornamental plants of various shapes, types and sizes. It is supported by the high demand for exports and imports of ornamental plants, so the need for these ornamental plants must be met.

Ornamental plants in Indonesia are very diverse. The begonia plant is one ornamental plant commodity often in demand by the public. Begonia plants are ornamental plants that have unique leaf shapes and various flower colors. Apart from that, in various regions of Indonesia, begonia plants are used as vegetables and medicinal ingredients. Begonia (Begoniaceae) is an ornamental plant in the Angiospermae group that has characteristic leaves, namely varied leaf shapes, leaf sizes, leaf patterns, attractive leaf colors and colorful flowers.

The availability of begonia plants is essential, so many begonia plant cultivators propagate generatively (using seeds) and vegetatively (using plant parts). Generative propagation using seeds has a weakness: it takes a long time for begonia plants to produce flowers until seeds are formed. Vegetative propagation is an alternative because it has the same characteristics as the parent, and cutting material is easy to obtain. Stems, rhizomes and leaves can be used for vegetative propagation.

Vegetative propagation of begonia plants using leaves is more common because they have lots of leaves on the plant parts, and it is easier to get cutting material and use old parts rather than just throwing them away. Disadvantages of vegetative propagation include the cutting material rots quickly, the roots taking a long time to grow, and the cutting material dries out, which causes the death of the cutting material. This problem can be overcome by adding hormones or ZPT (Growth Regulators).

ZPT (Growth Regulator) is a stimulating substance that has already existed in the body of plants or has been deliberately added by humans. It is helpful as a stimulant for roots, flowers and fruit. The auxin PGR influences the growth and development of cuttings. One of the PGRs that contains synthetic auxin is Rootone F. Synthetic auxin is used and applied more often because it is practical and more accessible to obtain in agricultural shops at an affordable price.

Based on the explanation above, this research uses leaf cuttings and Rootone F at various concentrations, which provide the best results regarding the success percentage of red star begonia (velvet rhizomatous) cuttings.

LITERATURE REVIEW

Begonia

The begonia plant is an ornamental plant that has beauty in the shape and color of the leaves. The name Begonia was given by a priest who is also a botanist, Charles Plumier (Efendi & Maryanti, 2017). According to Suryani (2014), the classification of begonia plants is as follows:

Kingdom	: Plantae
Super Division	: Spermatophyta
Division	: Magnoliophyta
Class	: Magnoliopsida
Order	: Violales
Family	: Begoniaceae
Genus	: Begonia
Cultivar	: Black Velvet

Characteristics of Begonias are characterized by asymmetrical, oval, finger-shaped leaves, like palm leaves, trumpets or tassels, depending on the species. Most of the leaves in Borneo have round to elongated shapes. The leaves are scattered in various colors and patterns. The leaves are thin, semi-thick to thick (Kiew et al., 2015).

Begonia is an easy-to-recognize plant because it has specific characteristics: upright, bushy or creeping grass with succulent stems and asymmetrical leaves (begonifolia) (Dewitte et al., 2011). Begonias usually grow in groups on forest cliffs, mountains, limestone, waterfalls, or rocky and damp river banks. Begonias grow at an altitude of 20-1800 meters above sea level. Herbaceous (sometimes epiphytic) or undershrub and rhizomatous terrestrial begonia types can be found in humid subtropical

and tropical climates (Tebbitt, 2005 in Undaharta and Utomo, 2016). Begonias grow well in damp places, humus soil, and slightly shaded places ranging from an altitude of 900 m to 2,300 m (Munawaroh & Siregar, 2018).

Rootone F

The widely used auxin growth regulator is Rootone F, a growth hormone traded in powder form. It is white and insoluble in water and helps accelerate and increase the formation of new roots. Based on the packaging label of Rootone F, the ingredients contained in Rootone F are NAA, NAD, MNAA and IBA (Fatona et al., 2012).

Synthetic growth regulators that are often used from the auxin group are indole-3 butyric acid (IBA) and naphthalene acetic acid (NAA) with the trade name Rootone F (Gumelar & Ari, 2019). Rootone F is a synthetic PGR whose active ingredients are a combination of IBA (Indole Butyric Acid) and NAA (Naphthalene Acetic Acid), which is very effective in stimulating sprouting, growth and rooting of cuttings (Hadi, 2020).

Rootone F has the valuable function of stimulating the growth of new roots in plants. ZPT is an organic compound that is not a nutrient, but in small amounts, it can support, inhibit and change plant physiological processes (Azmi et al., 2018).

Begonia Plant Propagation

Propagation of this type of Begonia is mostly done vegetatively rather than using seeds because it can produce shoots in large and uniform numbers. In addition, they reach maturity faster than seeds. Vegetative propagation can be done by stem and leaf cuttings. Fresh stem cuttings and leaves are planted in a combination of forest humus and raw husks (Efendi, 2018).

Based on the research results of Arinasa (2015) regarding the use of Rootone F concentrations at various levels, it is known that the optimum concentration for the growth of *Begonia tuberosa* Lmk shoot cuttings. Namely 300 mg/l. The development of cuttings resulted in leaf area, oven-dry root weight, oven-dry stem weight, oven-dry ultrangular weight, total oven-dry seedling weight, and the age at which the seedlings were ready to be transferred to pots, which were higher compared to the control.

Begonia propagation can be done generativity and vegetatively. The vegetative plant propagation technique is through cuttings. This technique utilizes vegetative material from plants and grows it into individual plants. One way to propagate begonias is through leaf cuttings (Wibawa & Lugrayasa, 2019). The vegetable propagation of begonia plants (*Begonia sp.*) uses complete leaves or only leaf slices because the leaves are thick and fleshy; leaf cuttings are carried out in large leaf veins cut below the surface of the mature leaves. The cuttings are then placed in the planting medium. Place

the cuttings flat on a damp medium. Roots will form in each piece of leaf bone, and the original cutting material will rot (Deviani et al., 2020).

METHOD

The research was carried out in April - June 2023 in a Greenhouse measuring 4x6 m located in Claket Village, Pacet District, Mojokerto Regency. This area has an average height of 950 meters above sea level (masl). The average temperature is 24°C. The tools used are germination tanks, measuring cups, label boards, digital scales (pocket scale 200g/0.01g), plant-cutting scissors, spray bottles, and 1.5L plastic bottles. The materials used are whole leaves and sliced leaves from the parent red star begonia plant obtained from the cultivation of residents around Pacet and Claket Villages, Mojokerto Regency, distilled water, 90% alcohol, Rootone F (PT. Rhone-Poulenc Agrocarb), compost and husks.

The preparation of growth regulators is done by dissolving NAA and mixing each weighed Rootone F powder (0.25g, 0.3g, 0.35g, 0.4g) with distilled water at a dose of 1L. Next, shake the mixture in a plastic bottle until it dissolves. Each cutting material was soaked for 30 minutes. Planting is done by making a hole with a depth of ±5 cm in the center of the planting medium. The sliced leaf-cutting material is placed in a standing position, while the whole leaf-cutting material is placed in a sleeping position (Cahyadi et al., 2017). Maintenance is done by watering twice a day and weeding by removing weeds.

The research uses two factors. The first factor, the cutting material, consists of whole and sliced leaves. The second factor, namely the concentration of Rootone F, consists of 250 ppm, 300 ppm, 350 ppm, and 400 ppm. Each treatment was combined to create eight combination treatments. For each combination treatment, 25 cuttings were planted in 1 germination tank in five longitudinal and five transverse positions.



Figure 1. Planting Model

Observation parameters include the percentage of sprouting cuttings, the percentage of rooted cuttings, and the percentage of live cuttings at 7 WAP (Week after Planting). With the following formula:

$$\text{Percentage of rooted cuttings} = \frac{\text{total rooted cutting}}{\text{total cuttings planted}} \times 100\%$$

$$\text{Percentage of sprouting cuttings} = \frac{\text{total of cuttings grow shoots}}{\text{total cuttings planted}} \times 100\%$$

$$\text{Percentage of live cuttings} = \frac{\text{total live cutting}}{\text{total cuttings planted}} \times 100\%$$

RESULTS AND DISCUSSION

Percentage of Rooted Cuttings

Table 1 shows the results of calculating the percentage of rooted cuttings by cutting material treatment and Rootone F concentration.

Table 1. Percentage of Rooted Cuttings Aged 7 WAP on Cutting Material and Rootone F Concentration

Treatment		Percentage of Rooted Cuttings (%)
Cuttings Material	Rootone F Concentration	
B1 (Whole Leaves)	Z1 (250 ppm)	48.00%
	Z2 (300 ppm)	60.00%
	Z3 (350 ppm)	72.00%
	Z4 (400 ppm)	92.00%
B2 (Sliced Leaves)	Z1 (250 ppm)	56.00%
	Z2 (300 ppm)	64.00%
	Z3 (350 ppm)	84.00%
	Z4 (400 ppm)	60.00%

Table 1 shows that the highest percentage of rooted cuttings aged 7 WAP was found in the whole leaf treatment with a Rootone F concentration of 400 ppm (B1Z4) of 92% and the sliced leaf treatment with a Rootone F concentration of 350 ppm (B2Z3) of 80%. The lowest percentage of rooted cuttings was found in the whole leaf treatment with a Rootone F concentration of 250 ppm (B1Z1) at 48% and the sliced leaf treatment with a Rootone F concentration of 250 ppm (B2Z1) at 56%.

The observation parameters for the highest percentage of rooted cuttings were in the whole leaf treatment with a Rootone F concentration of 400 ppm and the sliced leaf treatment with a Rootone F concentration of 350 ppm. Rootone F in whole leaf cuttings can accelerate the root growth, thereby increasing shoot growth. Growth hormones in a certain amount (optimal) will actively regulate critical metabolic reactions and stimulate the growth of root provides. It is supported by large, intact leaves that store photosynthetic reserves. It can stimulate root growth and, in turn, stimulate shoot growth. Root growth in cutting material can be an essential factor in the initial growth of cuttings. Roots can grow with cuttings, which is hoped to support further growth in the cuttings. It is the statement of Taam et al. (2020) that the formation of cutting roots is influenced by the carbohydrate content and the balance of hormones contained in the planting medium and is supported by the statement of

Egamberdieva (2013) stating that the carbohydrate content in plants is needed for the formation and growth of plant tissue, the rate of Rapid growth requires more carbohydrates. According to Mulyani and Ismail (2015), the function of auxin is to stimulate the growth process, both leaf growth and root growth, accelerate germination, and stimulate the process of cell division.

Initial growth is characterized by growing roots, which can become the initial growth of cutting material. Root growth in cuttings is an early sign of growth, so it is hoped that cuttings will grow shoots with root growth. Furthermore, Masli et al. (2019) state that if there are roots, there is still a possibility that the cutting material can still live. However, if the cutting material does not yet have roots, the cutting material may die, so the roots' growth can determine the cuttings' life. If the cuttings produce shoots without roots growing, then it is certain that the cuttings will not survive. It is due to running out of food reserves and not being able to absorb nutrients in the existing media, but cuttings can produce roots even without shoots; the cuttings can still survive by absorbing nutrients in the media.

Percentage of Sprouting Cuttings

Table 2 shows the results of calculating the percentage of cuttings that sprouted using cutting material treatment and Rootone F concentration seven weeks after planting (WAP).

Table 2
 Percentage of Germinating Cuttings Aged 7 WAP on the Effect of Cutting Material and Rootone F Concentration.

Treatment		Percentage Of Sprouting Cuttings (%)
Cuttings Material	Rootone F Concentration	
B1 (Whole Leaves)	Z1 (250 ppm)	36.00%
	Z2 (300 ppm)	56.00%
	Z3 (350 ppm)	64.00%
	Z4 (400 ppm)	80.00%
B2 (Sliced Leaves)	Z1 (250 ppm)	40.00%
	Z2 (300 ppm)	52.00%
	Z3 (350 ppm)	68.00%
	Z4 (400 ppm)	40.00%

Table 2 shows that the highest percentage of sprouting cuttings was found in the whole leaf treatment with a Rootone F concentration of 400 ppm (B1Z4) of 80% and the sliced leaf treatment with a Rootone F concentration of 350 ppm (B2Z3) of 68%. The lowest percentage of cuttings that sprouted was found in the whole leaf treatment with a Rootone F concentration of 250 ppm (B1Z1) at

36% and the sliced leaf treatment with a Rootone F concentration of 250 ppm (B2Z1) and 400 ppm (B2Z4) at 40%.

The highest observation parameters for sprouting cuttings were in the whole leaf treatment with a Rootone F concentration of 400 ppm and the sliced leaf treatment with a Rootone F concentration of 350 ppm. If the cutting material is treated with Rootone F, roots will grow. If the cutting material can grow roots, it is hoped to produce shoots in the subsequent growth due to the Rootone F content and the cutting material being in optimum conditions in the cutting material. The content of Rootone F, which consists of IBA and NAA compounds, is a compound that has the power to work like auxin; that is, at the right concentration, it will increase division, cell elongation and differentiation in the form of segment extension with root growth.

Cutting material that has grown roots can then drain the nutrients and water in the planting medium to support the photosynthesis process in the cutting material. The appearance of shoots on cuttings is due to the availability of sufficient food substances so that the presence of phytohormones is active in dividing cells. According to Panggalo et al. (2019), shoot formation is influenced by the interaction between auxin and cytokinin, which increases differentiation and cell division. Synthetic ZPT hormone treatment can activate the performance of auxin from within the plant and increase the cytokinin hormones contained. Asra et al., (2020) explained that the emergence of shoots on cuttings is influenced by the food reserves included in the cuttings, which are supported by the growing environment, such as temperature, water availability, light, and elements of the soil media used. According to Fitriyanti et al. (2021), the factors that influence the growth of cuttings are internal factors, including genetic factors, enzymes and hormones, while external factors include nutrition, light, water, temperature, humidity and sufficient nutrients and minerals.

Percentage Of Live Cuttings

The criteria for calculating the number of live cuttings are whether the cutting material has grown shoots and roots.

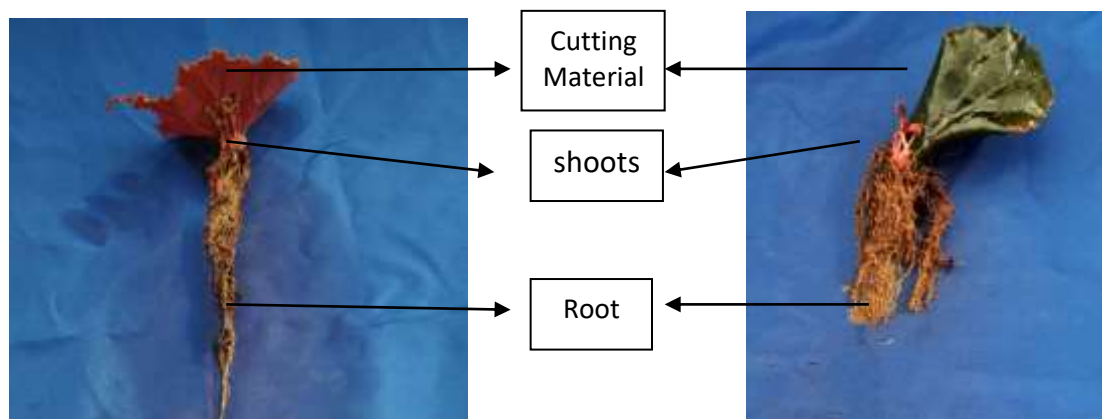


Figure 2. Cuttings Result (a) Whole Leaves (b) Sliced Leaves

The results of calculating the percentage of live cuttings on cutting material with a concentration of Rootone F aged seven weeks after planting (WAP) can be seen in Table 3.

Table 3
 Percentage of Live Cuttings Aged 7 WAP on the Effect of Leaf Cutting Material and Rootone F Concentration.

Treatment		Percentage of Live Cuttings (%)
Cuttings Material	Rootone F Concentration	
B1 (Whole Leaves)	Z1 (250 ppm)	36%
	Z2 (300 ppm)	56%
	Z3 (350 ppm)	64%
	Z4 (400 ppm)	80%
B2 (Sliced Leaves)	Z1 (250 ppm)	40%
	Z2 (300 ppm)	52%
	Z3 (350 ppm)	68%
	Z4 (400 ppm)	40%

Table 3 shows that the highest percentage of live cuttings was found in the whole leaf treatment with a Rootone F concentration of 400 ppm (B1Z4) of 80% and the sliced leaf treatment with a Rootone F concentration of 350 ppm (B2Z3) of 68%. The lowest percentage of live cuttings was found in the whole leaf treatment with a Rootone F concentration of 250 ppm (B1Z1) at 36%, while the sliced leaf treatment with a Rootone F concentration of 250 ppm (B2Z1) and a Rootone F concentration of 400 ppm (B2Z4) was 40%.

Observing the percentage of live cuttings at 7 WAP showed that the highest results were from whole leaf treatment with a Rootone F concentration of 400 ppm and sliced leaf treatment with a Rootone F concentration of 350 ppm. The observation time of 7 WAP is sufficient for the cutting material to have roots and shoots. Because the process of adapting to the environment has occurred, cutting material with an optimal concentration of Rootone F can stimulate the growth of roots and shoots from the cutting material. Cuttings that have been soaked in Rootone F encourage endogenous hormones in the cuttings to be stimulated more quickly by adding exogenous hormones that contain auxin. Latief et al. (2015) stated that auxin in Rootone F is a hormone widely used as a plant growth regulator (ZPT), which stimulates shoot growth and the emergence of new shoots. Santoso (2022) states that auxin plays a role in exchanging H⁺ ions and K⁺ ions, increasing cell permeability, increasing cell wall elasticity, breaking several hydrogen cross-links, and synthesizing proteins as growth energy. These physiological processes cause the tip meristem and coleoptile to regenerate and differentiate to form a growing point, followed by the formation of a shoot, which is then pushed out and continues to develop into a shoot.

The combination treatment of whole leaf cuttings and Rootone F concentration of 400 ppm was done to meet the availability of ZPT absorption needed by plants during the root growth phase, thereby causing plants to be able to increase the absorption of water and nutrients. If plant roots are good, it will improve plant parts' growth and development, such as shoots and roots. Chintya (2018) states that Rootone F is an artificial hormone that is grouped into the auxin group containing IAA (*indole acetic acid*), IBA (*indole butyric acid*) And NAA (Naphthalene acetic acid). IAA plays a role in accelerating the elongation of cells in plant root meristem tissue, while IBA and NAA play a vital role in the formation of root hairs. Rohandi (2010) states that giving PGR, which contains auxin, can accelerate the formation of shoots and leaves and increase root length.

CONCLUSION

This research concluded that propagating begonia plants using whole leaf parts with a Rootone F concentration of 400 ppm gave very satisfactory results. The parameters measured showed a high success rate, namely the percentage of rooted cuttings reached 92%, the percentage of sprouted cuttings was 80%, and the percentage of live cuttings was also 80%. This shows that this method is effective in propagating begonia plants, with most cuttings able to develop new roots and shoots and survive well. This high success can be caused by the optimal hormone content in Rootone F 400 ppm, which helps speed up the rooting process and shoot growth. Therefore, the use of whole leaf parts and appropriate hormone concentrations can be recommended as an efficient and effective technique for begonia propagation, both for research purposes and practical applications in horticulture.

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