

## **Koja Banana Plantlet Acclimatization at Various Concentrations of Foliar Fertilizer and Length of Containment**

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### **Abstract**

Koja is a widely known variety of bananas but the availability of high-quality seeds has not been able to meet the market demand. This problem is overcome by using tissue culture, meanwhile, the success of the culture is largely determined by the acclimatization stage or adaptation of plants from *heterotrophs* to *autotrophs*. Therefore, this study aims to determine the interaction between the concentration of foliar fertilizer and the length of containment as well as the appropriate concentration for the growth of Koja banana plantlets. This is a field experiment carried out with a 2-factors *split-plot* design. The *main plot* was the foliar fertilizer concentration namely M1 = 2 ml/L; M2 = 4 ml/L; M3 = 6 ml/L, while the *subplots* were the length of containment namely E1 = 10 days; E2 = 20 days; E3 = 30 days. Based on the results, there was an interaction between the concentration of foliar fertilizer 4 ml/L and the length of containment of 20 days on the height, root volume, as well as fresh and plant dry weight.

**Keywords:** Koja Banana, Acclimatization, Foliar Fertilizer, Length of Containment



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### **INTRODUCTION**

Bananas are one of the fruit commodities widely consumed due to the cheap price and good nutritional quality. Several parts of the plant have potential benefits such as the fruit which is consumed, the undeveloped flowers as vegetables, and the leaves for wrapping food. Furthermore, the harvested area and banana production rank first in relation to the total production of other fruits (12).

Koja banana is a widely cultivated variety but the cultivation needs to be supported by innovation or appropriate technology. The conventional method of plant propagation using weeds or tillers only produces seeds in small quantities (5-10 seedlings per clump per year), takes a long time, is not uniform, and is not entirely free from disease and pests. However, these problems are overcome by utilizing *in vitro* culture (4).

*In vitro* culture has several advantages, including providing large quantities of seeds, retaining the parents' characteristics, producing seeds free of pests and diseases, as well as good uniformity of planting material. The success of plantlets growth in the culture is largely determined by the acclimatization stage (4).

Acclimatization of plant plantlets is the process of adapting to a transition from a controlled to an uncontrolled environment through *in vitro* techniques. Plantlets maintained in controlled conditions with the optimal environment (temperature and humidity), are very susceptible to high transpiration and die easily when exposed to an uncontrolled environment, therefore, acclimatization is required to adapt the plantlets to field conditions (1).

The acclimatization stage needs to be carried out for growth and development to obtain new plants that are ready to be planted in the field (8). The plant at this stage is very weak, therefore, nutrients are added to increase growth by spraying foliar fertilizers (9). In addition, it is necessary to adapt the plants by reducing air humidity and gradually increasing the light intensity through containment(8)

## LITERATURE REVIEW

Acclimatization aims to adapt seedlings grown by *in vitro* culture to an *autotrophic* environment. It is carried out by transferring plantlets to media with low light intensity and high relative humidity, then gradually lowering the humidity and increasing the light intensity. Factors that affect plantlet growth include planting media, light intensity, nutrient content, humidity, and room temperature (7).

Meanwhile, fertilization aims to provide nutrients for optimal plant productivity through the application on the leaves or the soil. Leaves application is more effective given that it allows about 90% absorption of the fertilizer, while the roots only absorb 10%. When applying fertilizer in liquid form, the concentration of the solution given needs to be considered, as each plant species has a different level of need (6).

Containment is required to maintain temperature, humidity, stability, as well as to prevent pests and diseases. It is carried out in two ways namely single for a specific plant and mass for all plants. The single approach is more beneficial given that the temperature and humidity are stabilized, while the mass is more practical (2).

## RESEARCH METHOD

The materials used include Koja banana plantlets aged 4 months, sand, compost, vitamin B1, leaf fertilizer, clear plastic, plastic straws, sprayers, scales, oven, camera, ruler, label, and stationery.

This study is a field experiment with a 2-factor split-plot design method. The first factor is the concentration of foliar fertilizer which consists of 3 levels namely 2 ml/L, 4 ml/L, and 6 ml/L while the second factor is the length of containment which also consists of 3 levels namely 10 days, 20 days, and 30 days. Furthermore, the data were analyzed by Analysis of Variance at 5% level and further tested with DMRT 5%.

The plantlets were planted in plastic pots filled with sand and compost (1:1), stored according to treatment, sprayed with foliar fertilizer 31 days after planting in the morning vitamin B1 once a week.

## FINDING AND DISCUSSION

Fertilizer application with a concentration of 4 ml/L and length of containment of 20 days showed significant effects on plant height, root volume, as well as fresh and dry weight as shown in Table 1.

Table 1. Average plant height (cm), Root Volume (mL), Plant Fresh Weight (g), and Dry Weight (g) at various concentrations of foliar fertilizer and length of containment

Treatment	Average			
	Plant Height (cm)	Root Volume (mL)	Plant Fresh Weight (g)	Plant Dry Weight (g)
M1E1	99,67 bc	52,33 e	302,00 d	14,00 d
M1E2	97,00 bc	68,67 c	448,40 b	27,77 bc
M1E3	104,33 bc	57,33 de	406,73 c	21,13 c
M2E1	107,00 bc	99,33 b	449,73 b	30,33 b
M2E2	125,33 a	125,00 a	508,33 a	39,43 a
M2E3	105,67 bc	101,67 b	431,60 bc	31,60 b
M3E1	101,33 bc	67,33 cd	402,63 c	22,67 c
M3E2	109,33 b	92,67 b	408,83 c	24,27 c
M3E3	100,33 bc	58,67cde	415,73 c14	21,67 c
Interaction	(+)	(+)	(+)	(+)

Information: The average followed by the same letter notation in the same column and row showed no significant difference at the 5% DMRT level. The sign (+) indicates there is an interaction.

The plant height and root volume produced were 125.33 cm and 125.00 mL, respectively. This shows that there is a synergistic relationship between foliar fertilizer and length of containment. Bio grow fertilizers contain phosphorus, microbes, and auxin growth regulator, the phosphorus function to increase the growth, development, and expansion of the root system to optimize nutrient absorption (14). It also contains microorganisms such as *Azotobacter* sp., *Bacillus* sp., *Pseudomonas* sp., and BPF which dissolve phosphate for plant absorption, while the auxin content enhances plant growth by elongating cells to increase the length, and volume (3).

The larger the root volume, the greater the nutrients absorbed and the taller the plant, this is due to the competition for the absorption of water and nutrients in the root volume. Root growth is improved through absorption, as well as the incorporation of water and nutrients needed for better plant metabolism (10). Furthermore, roots are the main vegetative organs that supply water, minerals, and essential materials for plant growth and development.

The 20 days length of containment is the right time to open the lid because the plant has passed a critical period in the acclimatization stage. In addition, stem lignification and palisade parenchyma have been formed, while the stomata and carrier bundles functioned perfectly, therefore, the plant responded optimally when sprayed with foliar fertilizer.

The foliar fertilizer treatment of 4 mL/L and length of containment of 20 days had the heaviest weight of 508.33 grams. This is because the treatment produced the highest plant height and root volume. Plants require nutrients in sufficient quantities to support growth, meanwhile, the ability to absorb water and nutrients by long roots increases fresh weight (5). Furthermore, the fresh weight is the composition of nutrients and water in a tissue while the dry weight is a growth indicator obtained from the total growth and development of the plant throughout the lifetime.

Proper containment with the right period protects plants from pests or diseases and retain CO<sub>2</sub> gas released during photosynthesis. It also serves to maintain the planting media humidity to prevent rapid loss of water. The major components of photosynthesis namely CO<sub>2</sub> and water use sunlight to convert solar into chemical energy which is then stored in fruits, leaves, stems, and roots as food reserves (13).

Regarding the dry weight, foliar fertilizer treatment of 4 mL/L and 20 days length of storage had the heaviest dry weight of 39.43 grams. Dry weight is the value obtained after drying a material and is the accumulation of photosynthate. According to (5), it is a plant growth indicator of assimilates obtained from the total growth and development. Meanwhile, (11) stated that the storage treatment function to maintain the humidity thereby preventing the planting media from rapid water loss.

## CONCLUSION AND FURTHER RESEARCH

Based on the results, the foliar fertilizer concentration 4 mL/L and length of containment of 20 days affected plant height, root volume, as well as fresh and dry weight at the acclimatization stage. However, further studies are needed to reproduce these results on the field.

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