



The Effect of Chopped Corm Sizes and Types of Soaking Material on Growth Seedling of Kepok Banana (*Musa paradisiaca* L. ABB Kepok)



I Nyoman Rai ^a, I Made Sudana ^b, I Nyoman Gede Astawa ^c, Rindang Dwiyani ^d

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Corresponding Author ^a



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BA;
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Kepok banana;
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seedling and soaking;

Abstract

This research was conducted to study the effect of chopped corm sizes and types of soaking material on growth seedling of Kepok banana. The study was conducted at green house used a factorial randomized block design with 2 treatment factors. The first factor was chopped corm sizes (in length x width x height), consists of 3 levels i.e. small size 5 x 5 x 5 cm (B₁), medium size 7 x 7 x 7 cm (B₂), and large size 9 x 9 x 9 cm (B₃). The second factor was types of soaking material, consists of 4 levels i.e. soaked in water only (R₀), soaked with Dithane M-45 fungicide 2g/l (R₁), soaked with Dithane M-45 fungicide 2 g/l + NAA hormone 100 ppm (R₂), soaked with Dithane M-45 fungicide 2 g/l + BA hormone 75 ppm (R₃), and soaked with the Dithane M-45 fungicide 2 g/l + NAA hormone 100 ppm + BA 75 ppm (R₄). The result showed that the combination treatment of 9 x 9 x 9 cm chopped corm size and soaking with Dithane M-45 2 g/l + BA hormone 75 ppm resulted in the highest growth of Kepok banana seedling, indicated by the highest height and dry-oven weight of seedling.

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Contents

Abstract.....	32
1 Introduction.....	33
2 Materials and Methods.....	34

^a Agroecotechnology Study Program, Faculty of Agriculture, Udayana University, Indonesia.

^b Agroecotechnology Study Program, Faculty of Agriculture, Udayana University, Indonesia.

^c Agroecotechnology Study Program, Faculty of Agriculture, Udayana University, Indonesia.

^d Agroecotechnology Study Program, Faculty of Agriculture, Udayana University, Indonesia.

3	Results and Discussions	34
4	Conclusion	38
	Acknowledgments.....	38
	References	39
	Biography of Authors	41

1 Introduction

Bananas are classified as important fruit plants in Indonesia. This plant is widely cultivated not only in the yard or in the garden on a small scale but also cultivated as a plantation crop on a commercial scale. Also, Indonesia is one of the countries with the highest diversity of bananas in the world (Convention on Biological Diversity, 2017). According to Prabawati *et al.* (2008) in Indonesia, there are 230 types of bananas, spread throughout the province so that almost all regions in Indonesia produce bananas. Indonesian banana production is also high and ranks sixth in the world, but in global banana exports, it ranks only 60th (FAO, 2018).

Kepok Banana (*Musa paradisiaca* L. ABB Kepok) is the result of a cross between *Musa acuminata* with the AA genome and *Musa balbisiana* with the ABB genome (Wahyuningtyas, 2009; Carmona-Garcia *et al.*, 2009; Borges *et al.*, 2005; Pelissari *et al.*, 2013). Kapok banana is one type of banana that has high economic value because of its high adaptability (Rai *et al.*, 2018), its use is very broad that can be consumed directly or as processed material which has good taste and sweetness (sugar content reaches 300 %brix) (Kasrina, 2013; Valentine *et al.*, 2015). According to Israel *et al.* (2015), countries that process bananas into chips and banana cakes, 95% of them use the type of Kepok banana. Reginio *et al.* (2018) stated that the Kapok banana is classified as a very important and popular type of banana compared to other banana cultivars so that it is widely developed in various countries, especially in Southeast Asia.

Banana production in Indonesia over the past 5 years has decreased very dramatically, from 82.27 tons in 2015 to 68.82 tons in 2019 (Deptan, 2020). Besides due to high pest and diseases attacks, one of the obstacles in the development of bananas in Indonesia is the difficulty in obtaining vigorous and healthy seedling in sufficient quantities as needed.

Propagation of banana seedlings can be done by separating tillers, using chopped corm and tissue culture techniques. Each method has both advantages and disadvantages. The method of separating tillers from banana clumps is easy, but produces non-uniform seedlings and can cause disease for the main plants and seedlings taken as a result of the wound due to separation (Tumuhimbise & Talengera, 2018). Propagation through tissue culture can produce uniform seedling in large quantities over time but requires high capital, skill requirements and somaclonal variations often occur (Kasyoka *et al.*, 2010). Propagation by chopped corm produces fewer seedlings than tissue culture, but the costs are lower and skills are less so that it is more easily applied by farmers (Nyawira *et al.*, 2017; Prabhuling & Sathyanarayana, 2017; Kishor *et al.*, 2017; Tumuhimbise & Talengera, 2018). With these considerations, this research tries to produce vigorous and healthy Kapok banana seedlings using different chopped corms size.

Banana corm is an organ called "tuberous rhizome" which acts as a true stem on the banana plant, located underground just above the pseudostem (Bhende & Kurien, 2015; Nunez-Santiago *et al.*, 2004; Parmar & Kar, 2007). The chopped corm can be used as a source of propagation for seedlings because of the presence of side nodes that have the potential to grow into juvenile bananas. One obstacle in the multiplication by using corm is the limited number of parts of chopped corm that are obtained because from one chopped corm will grow just one bud that will later grow into one vigorous and healthy banana seedling. According to Dewi (2016), the size of the chopped corm that is too large will require a wider nursery space, causing the inefficient production of large-scale seedlings. For that, it is necessary to try the use of different sizes of the chopped corm.

To ensure that the buds of the chopped corms can grow properly, it is necessary to protect the buds from infection with fungicides and stimulate the growth of buds by immersion in growth hormones. The results of Firmansyah (2011) showed that immersion with Dithane M-45 fungicide concentration of 2 g/l in Kepok banana nurseries was able to reduce fungus attacks compared without immersion of fungicides. Saputra (2016) found that the immersion of chopped corm of Kapok Kuning banana with hormone benzyl adenine (BA) concentration of 50-100 ppm significantly increased bud growth. The same thing was obtained by Sukowardana *et al.* (2015) that giving of BA 50, 100, and 150 ppm concentrations in Kepok Manado bananas significantly increased

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seedling growth compared to control. Besides soaking with BA, soaking with auxin hormone is estimated can increase the growth of banana seedlings in the multiplication with chopped corm. According to [Mahfudza et al. \(2018\)](#), the use of NAA concentrations of 1-5 ppm in in-vitro Cavendish banana propagation increased the number of buds and roots compared to controls. [Avivi et al. \(2013\)](#) stated that giving 0.5 ppm NAA concentration increased root length and number of roots in the propagation of Raja, Kepok, and Mas bananas with tissue culture, with an acclimatization success rate reaching 90%.

2 Materials and Methods

The study was conducted at green house in the Experimental Field of Faculty of Agriculture Udayana University, from February to May 2020. Analysis of variables conducted at Laboratory of Integrated Service, Faculty of Agriculture Technology Udayana University, and Laboratory of Agronomy & Horticulture and Laboratory of Soil Science Faculty of Agriculture Udayana University. The study used a factorial randomized block design (RBD) with 2 treatment factors. The first factor was chopped corm sizes (in length x width x height), consists of 3 levels i.e. small size 5 x 5 x 5 cm (B₁), medium size 7 x 7 x 7 cm (B₂), and large size 9 x 9 x 9 cm (B₃). The second factor was types of soaking material for chopped corm consists of 4 levels i.e. soaked in water only (R₀), soaked with Dithane M-45 fungicide 2g/l (R₁), soaked with Dithane M-45 fungicide 2 g/l + NAA hormone 100 ppm (R₂), soaked with Dithane M-45 fungicide 2 g/l + BA hormone 75 ppm (R₃), and soaked with the Dithane M-45 fungicide 2 g/l + NAA hormone 100 ppm + BA 75 ppm (R₄). Thus, there were 12 combination treatments and each was repeated 3 times.

Corm of Kepok banana was taken from the parent banana whose fruit has been harvested. The corm washed clean then air-dried, after that cut with the size according to the treatment of chopped corm size. The chopped corms then soaked according to the type of soaking material treatments. Technical immersion in the treatment of R₀, chopped corm soaked in water for 30 minutes, on R₁ soaked with Dithane M-45 for 10 minutes then dried, in R₂ soaked with Dithane M-45 for 10 minutes then dried for 10 minutes, then soaked again in 100 ppm NAA hormone solution for 1 minute and then air-dried. In R₃ soaked with Dithane M-45 for 10 minutes, then air-dried for 10 minutes, after which they have soaked again in a 75 ppm BA hormone solution for 1 minute. In R₄, the chopped corm soaked with Dithane M-45 for 10 minutes, air-dried for 10 minutes, then soaked with 100 ppm NAA for 1 minute after that drained for 3 minutes, then soaked again at BA 75 ppm for 1 minute. The chopped corms that have been immersed then planted in a polybag.

Planting begins with the preparation of planting media. The planting media was a mixture of soil, husks, and manure with a composition of 1:1:1 (v:v:v). Planting media was put into a 5 kg polybag until full. Chopped corms that have been given immersion treatment were planted in polybags with a depth of 3-5 cm from the surface. Maintenance was carried out intensively including watering, pest and diseases, and weed control.

The experiment ended 3 months after planting the chopped corms, with the criteria that the banana seedlings are ready to be moved to the field and with the minimum number of leaves is 4. Variables observed were leaf number, seedling height, seedling stem diameter, root length, primary root number, leaf chlorophyll content, relative water content (RWC) of leaves, the dry-oven weight of seedling, leaf N and P nutrient content, leaf carbohydrate content (reducing sugars and sucrose), and percentage of seedlings with the disease.

3 Results and Discussions

The results of the analysis of variance showed the interaction between the sizes of chopped corm and the types of soaking material (BR) significantly affected the height and dry-oven weight of seedling. The sizes of chopped corm (B) significantly influenced the number of leaves, leaves chlorophyll content, stem diameter of seedling, root length, and the number of primary roots, while the types of soaking material (R) significantly influenced leaf chlorophyll content, reducing sugar and leaf sucrose content.

The highest seedling height and dry-oven weight were obtained at B₃R₂ combination treatments were 113.67 cm and 54.09 g, while the lowest at B₁R₂ namely 38.33 cm and 7.92 g. In the types of soaking material R₀, R₁, R₂, and R₄, the highest seedling height and dry-oven weight were obtained at B₃, whereas in R₃, the highest was obtained in B₂ (Table 1 and Table 2). This showed that if using the type of soaking material R₀, R₁, R₂, and

R₄, the chopped corm used is a large size of 9 x 9 x 9 cm, but if using R₃, the chopped corm used is a medium size of 7 x 7 x 7 cm. The results obtained in the immersion R₀, R₁, R₂, and R₄ following Firmansyah (2011) that the greater the size of the banana chopped corm the better the banana seedling, due to the larger chopped corm size the more food reserves contained to supply energy for buds grow and develop. According to Baiyeri & Aba (2007), the differences of chopped corm on Kepok banana have a significant effect on the percentage of growth, seedling growth speed, number of roots and leaves, and seedling height. In R₃, the height and dry-oven weight of seedling at B₃ was lower than that of B₂ is similar to the result of Safrizal (2013) that the larger size of chopped corm does not always show a better variable growth value than the smaller one. According to Supriana et al. (2015), in chopped corm of banana there is cytokinin hormone that can affect bud growth. Allegedly in B₃, the concentration of the cytokinin hormone in the chopped corm is already high enough because the size of the chopped corm is greater than B₁ and B₂ so that with immersion in R₃ which there is cytokinin (BA) causes the cytokinin content in the B₃ chopped corm to be to high or no optimal. The combination of B₃R₂ or soaked with the NAA hormone concentration of 100 ppm for 1 minute has an impact on the ability of the chopped corm to produce the highest seedling height. The same result was also shown by Pratama (2012) on the propagation of pamele with cuttings, that giving NAA hormone produced a higher percentage of growth, seedling height, and number of roots than those of control. The effectiveness of treated hormone immersion is influenced by many factors; one of them is the ability of planting material to absorb the immersion material, caused by the differences in the area of absorption. Naturally, there are endogenous hormones in the chopped corm, so the success rate of synthetic hormones from outside absorbed by chopped corm is greatly influenced by the accumulation of endogenous and exogenous hormones. If the content of endogenous hormones is sufficient, the additional exogenous hormones given will cause inhibition of the growth of certain organs due to excessive hormone accumulation (Mukarlina, 2018), but conversely, if little endogenous hormones and added hormones from outside (exogenous) can accelerate seedling growth (Zein, 2016).

Table 1
Effect of the differences of chopped corm sizes and the types of soaking material on seedling height

Treatment s	Seedling height (cm)				
	R ₀	R ₁	R ₂	R ₃	R ₄
B ₁	66.00 bc	81.00 ab	38.33 c	79.00 ab	89.00 ab
B ₂	75.00 b	69.33 bc	81.67 ab	99.33 ab	75.00 b
B ₃	88.67ab	101.33 ab	113.67 a	79.67 ab	102.67 ab

Note: Numbers followed by the same letter in the same column and lane and diagonally showed no significant difference in Duncan's test of 5%.

Table 2
Effect of the differences of chopped corm sizes and the types material of soaking on dry-oven weight of seedling

Treatmen ts	Dry-oven weight of seedling (g)				
	R ₀	R ₁	R ₂	R ₃	R ₄
B ₁	22.68 bc	24.42 bc	7.92 c	27.15 b	32.13 b
B ₂	31.04 b	25.40 bc	31.57 b	44.70 ab	32.20 b
B ₃	40.56 ab	48.93 ab	54.09 a	32.91 b	46.22 ab

Note: Numbers followed by the same letter in the same column and lane and diagonally showed no significant difference in Duncan's test of 5%.

Different sizes of chopped corm have different effects on canopy and root growth of banana seedling. The differences in canopy growth can be seen from the number of leafs and stem diameter of the seedlings, while

the differences in root growth were reflected by the length of the root and the number of primary roots of the seedlings. In Table 3 can be seen, the greater the size of the chopped corm the greater number of leaf and diameter of the seedling stem produced. Similarly, root length and number of primary roots were also getting bigger. This condition proved that the larger size of the chopped corm will produce a better balance in the direction of seedling growth, that is not only increasing growth upwards (canopy) but also positively correlating to growth downwards (roots). The same results were shown by Dewi (2016) in the multiplication of banana, that larger size of splitted corm was able to increase canopy and root growth simultaneously. According to Putri (2017), difference sizes of chopped corm of banana causes has difference accumulation of carbohydrates and food reserves and its affect the ability and speed of the bud to grow and develop into seedling.

Improved canopy and root growth in larger chopped corm size was supported by higher leaf chlorophyll content and better ability to absorb nutrients and water. Although statistically was not significantly different, but the chlorophyll and RWC content of leaves in B₃ were 46.89 SPAD and 82.06% tended to be higher than that of in B₁ and B₂ (Table 3). Likewise, the nutrient content of N and P leaves in B₁, B₂, and B₃ were not significantly different, but the value in B₃ tended to be higher than that of in B₁ and B₂ (Table 4). This supports the process of photosynthesis in seedlings from larger chopped corm size be running better, reflected by higher content of reducing sugars (Table 4). Data from this study indicated that larger chopped corm size will support buds to grow better than smaller one. Hutasoit et al. (2013) stated that the greater the size of planting.

Table 3
Effect of the differences of chopped corm sizes and types of soaking material on number of leaf, chlorophyll and RWC content of leaves, stem diameter, length of root, and number of primary roots.

Treatments	Leaf number (unit)	Leaves chlorophyll content (SPAD)	Leaves RWC (%)	Stem diameter (cm)	Root length (cm)	Primary root number (unit)
Chopped corm sizes (B)						
B ₁	6.07 b	43.20 a	73.99 a	3.23 b	65.40 b	16.73 b
B ₂	6.07 b	46.64 a	80.83 a	3.99 a	65.93 b	19.67 b
B ₃	7.20 a	46.89 a	82.06 a	4.56 a	79.00 a	34.40 a
LSD 5%	1.05	5.83	10.78	0.62	10.07	8.37
Types of soaking material (R)						
R ₀	6.22 a	42.58 ab	73.75 a	3.77 a	60.00 a	21.00 a
R ₁	6.22 a	47.28 ab	79.12 a	4.02 a	67.56 a	20.11 a
R ₂	6.33 a	40.90 b	76.69 a	3.66 a	74.00 a	24.78 a
R ₃	7.11 a	48.64 a	79.04 a	4.13 a	75.67 a	23.33 a
R ₄	6.33 a	48.48 ab	86.12 a	4.04 a	68.33 a	28.78 a
LSD 5%	1.36	7.53	13.91	0.79	28.37	10.80

Note: The number followed by the same letter in the same column showed a significantly different level of LSD test at 5%.

Table 4
Effect of the differences of chopped corm sizes and the types of soaking material on N and P leaf content, reducing sugar and sucrose content of leaves and percentage of seedlings affected by disease

Treatments	N leaf content (%)	P leaf content (%)	Leaf reducing sugar content (mg/g)	Leaf sucrose content (mg/g)	Seedling affected by disease (%)*
Chopped corm sizes (B)					
B ₁	1.87 a	0.58 a	5.50 b	8.13 a	7
B ₂	1.77 a	0.64 a	6.74 a	7.42 a	20
B ₃	2.05 a	0.68 a	5.97 ab	7.78 a	20
LSD 5%	0.30	0.17	1.07	1.19	-
Types of soaking material (R)					
R ₀	1.70 a	0.55 a	4.47 b	8.95 a	28
R ₁	2.09 a	0.68 a	5.69 ab	9.16 a	6
R ₂	1.86 a	0.68 a	4.88 ab	8.14 ab	28
R ₃	1.91 a	0.64 a	8.32 a	5.64 b	6
R ₄	1.92 a	0.60 a	7.00 ab	6.97 b	12
LSD 5%	0.39	0.22	1.38	1.54	-

Note: The number followed by the same letter in the same column showed a significantly different level of LSD test at 5%.

*) data not statistical analyzed.

The material in mulberry propagation, the greater the speed of growth and height of seedlings. [Rapilah et al. \(2016\)](#) also found the same thing in a *Sansievera* nursery, that the larger cuttings size significantly increased the percentage of growth, height and number of seedlings than smaller one.

Soaking the chopped corm with the types of soaking material R₁, R₂, R₃ and R₄ resulted in higher number of leaf, RWC content of leaves, stem diameter, root length, number of primary roots and leaf P nutrient content than those of in R₀ although statistically was not significantly different. This showed that soaking with Dithane M-45 fungicide and BA and/or NAA hormones can increase the growth of seedlings upward to form the canopy and downward to increase root growth. Soaking at R₃ (BA hormone 75 ppm) gave the highest chlorophyll content that was 48.64 SPAD (Table 3). One of the functions of BA is to stimulate chlorophyll synthesis and prevent aging (senescence). According to [Baihaqi \(2017\)](#) the usage BA hormone is able to stimulate the growth of buds that will become the organ of the leaf to synthesize chlorophyll as a place for photosynthesis; in addition treatment of cytokines can stimulate the process of cell division and the formation of axillary buds.

Soaking the chopped corm with different types of soaking material affected the reducing sugar and leaf sucrose content. The highest leaf reducing sugar content obtained at R₃ (8.32 mg/g) and was significantly different with the lowest leaf reducing sugar content at R₀ (4.47 mg / g), but not significantly different with leaf reducing sugar content at R₁, R₂, and R₄. On the other hand, leaf sucrose content was lowest at R₃ (5.64 mg/g) and significantly different with leaf sucrose content at R₀ (8.95 mg/g). In general, soaking chopped of corm with soaking material containing hormones (R₂, R₃, and R₄) decreased the leaf reducing sugar content, but increased the leaf sucrose content (Table 4). The data showed that the immersion of chopped corm with soaking material containing BA and/or NAA caused higher accumulation of reducing sugar (sugar forms in photosynthesis) than that of without hormone, but the sucrose content as sugar that is easily translocated shows the opposite results. Based on these data, it is suspected that in banana nurseries a form of sugar that is easily transported (sucrose) is not stored for a long time in the leaves, but is immediately used for growth and metabolic processes. Increased growth and metabolic processes in seedlings that got BA and/or NAA hormone immersion were shown by the

higher number of leaves, leaf RWC, stem diameter, root length, and number of primary roots. Physiologically plants that are at the nursery stage (vegetative growth), most of the dominant photosynthesis results are used for growth rather than stored in the tissue so that the accumulation of sucrose in the leaves will be lower, because the sugar is sent to the growing meristematic tissues (tip of the buds and root). According to [Liu et al. \(2012\)](#), sucrose is a form of sugar that is generally transported in phloem by most plants.

Soaking the chopped corm with Dithane M-45 is quite effective in reducing the percentage of seedlings affected by the disease. This can be seen from the percentage of seedlings attacked by disease in R₁, R₃, and R₄ respectively 6, 6, and 12% while in R₀ (control) reaches 28%. The active ingredient contained in the Dithane M-45 is *mankozeb*, which works by chalking the elements needed by the pathogen so that the growth of the pathogen is inhibited. In addition, the active ingredient is able to initiate the formation of metabolites in plant physiologically into isothiocyanates which activate enzymes so that the development of amino acid synthesis of pathogenic organisms is inhibited and not developed ([Sumardiyono, 2008](#)). However, soaking with Dithane M-45 was not able to produce seeds that 100% disease-free. It is estimated because Dithane M-45 is a type of fungicide which works through contact so that its ability for protection and mold growth inhibition is limited. If the plant material contains systemic disease inoculum, contact fungicides tends to fail to overcome it. The same results were obtained by [Firmansyah \(2011\)](#) that treatment with contact fungicides in banana nurseries has not been able to produce fully healthy seedlings.

4 Conclusion

The combination treatment of 9 x 9 x 9 cm chopped corm size and soaking with Dithane M-45 2 g/l + BA hormone 75 ppm gave the highest growth of Kepok banana seedling, indicated by the highest height and dry-oven weight of seedling. As a single factor, the greater size of the chopped corm, the greater number of leaf, diameter of stem, root length and number of primary roots produced. Soaking the chopped corm with material containing BA and/or NAA hormones increased growth canopy and roots, while soaking with material containing Dithane M-45 reduces the percentage of seedlings affected by the disease.

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Biography of Authors

	<p>Prof. Dr. Ir. I Nyoman Rai, M.S. is a professor at Faculty of Agriculture, Udayana University. He is interested in fields of study included ecophysiology and horticulture. Currently, he is Lecturer at Faculty of Agriculture, Udayana University. His rank/class is IVd/ Professor of Udayana University. <i>Email: rainyoman@unud.ac.id</i></p>
	<p>Prof. Dr. Ir. I Made Sudana, M.S. is a professor at Faculty of Agriculture, Udayana University. He is interested in fields of study included pests and plant diseases. Currently, he is Lecturer at Faculty of Agriculture, Udayana University. His rank/class is IVd/ Professor of Udayana University. <i>Email: imadesudana74@yahoo.com</i></p>
	<p>Ir. I Nyoman Gede Astawa, M.P. is lecturer at Faculty of Agriculture, Udayana University. He is interested in the field study included horticulture and seed propagation. He currently rank/class is IVb/Head Lector/Associate Profesor <i>Email: gdastawa@yahoo.com</i></p>
	<p>Prof. Dr. Ir. Rindang Dwiyani, M.Sc. is a professor at Faculty of Agriculture, Udayana University. She is interested in fields of study included tissue culture and horticulture. Currently, she is Lecturer at Faculty of Agriculture, Udayana University. Her rank/class is IVc/ Professor of Udayana University. <i>Email: rindangdwiyani@yahoo.co.id</i></p>