UNIVERSITI MALAYSIA KELANTAN

Evaluation on Growth Performance of *Alocasia Longiloba* Miq.

by

Amirul Syafiq bin Mohd Sani

A report submitted in fulfilment of the requirements for the degree of Bachelor of Applied Science (Sustainable Science)

FACULTY OF EARTH SCIENCE

UNIVERSITI MALAYSIA KELANTAN

2017

ACKNOWLEDGEMENT

Firstly,I would like say Alhamdulilah and all praise to Allah forgive me strength to write this Final Year Project.As He always promises to those who work harder will get best result by His blessings.

For indeed, with hardship [will be] ease.

Indeed, with hardship [will be] ease.

Source:Holy Quran(Surah Al-Insyirah,Chapter 94,verse 5-6)

Secondly.,my sincere thanks to the Dean of Faculty of Eartth Sciences(FSB),who is also my academic supervisor,Prof.Madya.Dr.Aweng a/l Eh Rak for his motivation and support in completing this report.He give me a lot of motivation word so that I will not give up to finish up this report.

Thridly,I would like to express my deepest gratitudes to my supervisor,Mr. Zulhazman bin Hamzah for his superb guidance, caring, motivation, encouragement and patience throughout this period of study.He give me a lot knowledge about new things to me and also contributed many journals,books,and other reading material to complete this report.

Fouthly,I would like to express my sincere appreciation to my co-supervisors which is Dr. Suhaimi bin Othman and Miss Nur Kyariatul Syafinie Binti Abdul Majid for their marvellous guidances throughout this period of study.Dr Suhaimi help a lot in this study where he give a proper mechanism for do this study and give a solution for all kind of problem throughout this study.Miss Nur Kyariatul Syafinie Binti Abdul Majid also helped me a lot throughout this study by give a guidances,information,and supply important things for this study.Without them,this study will be not achieved.

Fifthly,,I would like to acknowledge my sincere appreciation to Miss Norhazlini binti Mat Zain,the post-graduated student which also research assistants of my supervisor, ,Mr. Zulhazman bin Hamzah.She helped me a lot throughout this study by show me the correct way to conduct this study and give a solution for any problem faced.She also give a motivation to me so I can finish up this academic report.

Sixthly, my sincere thanks to Ms Nur Hanisah Binti Abdul Malek for the nice guidance in making analytical statistics for this study,She guide me a lot about how to use statistic software and describing the data that will be present in this final year report.

Not forget,my sincere appreciation to Dr. Rozidaini Binti Mohd Ghazi,the head programme of Sustainable Sciences,for the advice and motivation to me along I am conducting this final year project.

Lastly,I would like to extend my fellow mates for the sample collecting,and helped me a lot through this study.We are facing all kind of obstacles but still stand strong to finish up this thesis report.Most importantly,I would like to thanks my lovely family who is my backbone along I am making this report.Their support and love make me keep strong and motivated to achieved what I am targeted.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

SPSS	Statistical Package for the Social Sciences

LIST OF SYMBOL

cm	Centimeter
˚C	Degree Celcius
N	North
W	West
mm	Milimeter

ABSTRAK

Alocasia Longiloba Miq. merupakan sebuah spesies dari genus Alocasia.Tumbuhan ini tersebar luas sekitar kawasan asia tenggara,. Sehinnga kini, tiada pendokumentasian mengenai pohon herba ini. Hanya segelintir masyarakat sahaja yang mengetahu khasiat pokok ini di mana ia mampu merawat penyakit kulit dan seterusnya mampu mengurangkan kebergantungan kepada ubat-ubatan moden.. Disebabkan itu, sebuah kajian telah dilakukan untuk memeriksa tumbesaran pada pokok keladi chanek ini .Kajian ini menggunakan saiz ubi yang berbeza iaitu besar,sederhana,dan kecil dan juga ubi bersama tunas dan ubi tanpa tunas Alocasia Longiloba Miq.untuk menguji kadar pertumbuhan pokok tersebut.Kajian ini telah dilakukan lapan minggu.Hasil kajian mendapati bahawa ubi bersaiz besardan ubi yang bertunas mempunyai kadar pertumbuhan yang cepat dari segi ketinggian pokok, diameter pokok, serta bilangan daun.

ABSTRACT

Alocasia Longiloba Miq. is a species of the genus Alocasia. These plants are widely distributed around the area of Southeast Asia,.So far, there is no documentation about this herb tree. Only a handful of people who know the benefits of this plants in which it is able to treat skin diseases and so able to reduce our dependence on modern medicines .. As a result, a study was conducted to examine trees growing on this “keladi chandek”. This study used a different tuber sizes of large, medium, and small and tubers with sprouts and potatoes without sprout *Alocasia Longiloba* Miq.untuk test the growth rate of the tree. The study was performed eight weeks. The study found that potato tubers sprout sized enormities have a rapid growth rate in terms of tree height, tree diameter, and number of leaves.

CHAPTER 1

INTRODUCTION

1.1 General Background

Alocasia is belongs to Araceae family which contains about 120 genera, and more than 1000 species. This plant usually found in the South and the Southeast Asia. Plants of this herbaceous monocot are terrestrials or lithophytes, usually evergreen, mostly rhizomatous, sometimes tuber-bearing perennials. *Alocasia* suitable for cultivation as valuable ornamental plants due to its foliage that has extravagant and exotic value.

Alocasia longiloba Miq. is one species of the *Alocasia* genus. This species is widely distributed in Malaysia, Cambodia, South Vietnam and South West China (Boyce, 2008). Like other species of *Alocasia*, this ornanmental plant has a potential become the natural medicine. Usually, this plant treat disease likes shingle disease. For that, this plant has the potential to become the traditional medicine. *Alocasia* species are conventionally propagated through seeds and tubers (Bhatt *et al*., 2013)

1.2 Problem statements

To date, there is a limit of studies has been done on propagation of *Alocasia longiloba* Miq. This plant also not really known by local mostly. Traditionally, this plant was used by local Malay as wound healing. From that, this plant can be the natural herb medicine so it can reduce the dependant uses of modern medicines which may has the unknown harmful subtances within the medicine itself.. In order to commercialized this product in modern approaches, technique to propagate *Alocasia longiloba* Miq. is needed and been published as the guidance of the product developer and also for the local people know more about this plant.

1.3 Objectives

The objectives of this study are as follows:

1) To observed the growth of *Alocasia longiloba* Miq tuber in three differences sizes which is small, medium, and large.

2) To investigate the growth performance of *Alocasia longiloba* Miq. of budding tuber and without budding tuber.

1.4 Scope of the study

This study focused on the measurement of the growth performance of *Alocasia longiloba* Miq. that planted in the mixture of cocoa peat and top soil which use the same ratio of 1:1. The materials involved was the tubers of *Alocasia longiloba* Miq. The tubers then divided into two different treatment which is the sizes and the buddings.

There are several limitations in this research that might lead to other researches in order to conduct further study. First, this study focus only on propagation of *Alocasia longiloba* Miq. tubers. So, other parameter that may contribute different result such as seeds, shoot, the stem, and other parts of *Alocasia longiloba* Miq. are excluded.

This research aimed only measured the growth rate of *Alocasia longiloba* Miq. using polybag composed at under shaded place. So, other paramater that might contribute to vary result of the growth performance of *Alocasia longiloba* Miq. such as soil medium, temperature, humidity, light intensity, rate of water spray are excluded.

1.5. Importance of the study

By addressing the identified problems, this study can be useful in many ways for the societies, the researcher, product developers and others.

First, this research can give an opportunity to society to become more knowledgeable about this *Alocasia longiloba* Miq. As a result, they would know the benefits and useful of *Alocasia longiloba* Miq. especially in medicine purpose. For the researchers or students, they can conduct more comprehensive and compatible research about propagation of *Alocasia longiloba* Miq. after the result of this study showed. Besides that, they can get more result that helped promoting *Alocasia longiloba* Miq. Product developers especially that in medicine producer can take this study for their references to make a product of *Alocasia longiloba* Miq.

CHAPTER 2

Literature review

2.1 General of Araceae

Known as the mesophytic plant families in tropical Asia, Araceae is the fouth largest family of monocotyledons after orchids, grasses and sedges (Mansor *et al*., 2012). Based on the recent record, there are about 118 genera and 3 500 species of Araceae worldwide (Boyce and Wong, 2013). In Peninsular Malaysia, there are about 140 species of 28 genera which recorded from 25 species are endermic (Mansor *et al*., 2012). Mostly of this species live in habitat that are moisture and humid (Boyce and Wong, 2013; Zulhazman *et al.*, 2012)

The sex of the individual flowers and their arrangement on the spadix are among the characters used to define this taxonomic groups and the spadix may bear are mostly uniformly and densely arranged over the spadix. (Boyce and Wong, 2013). Araceae are most diverse and abundant in the humid tropics (Boyce and Wong, 2013). Their life forms can be divided as shown in Table 2.1

:

Table 2.1: Life forms of Aracae

No	Life-forms	Genus
1	Hemiepiphytes (Primary and secondary)	*Pothos* *Rhaphidophora*
2	Epiphytes	*Remusatia* *Scindapsus*
3	Nanophanerophytes	*Aglaonema* *Apoballis*
4	Mesophytic herbaceous Phanerophytes	*Homalomena* *Apoballis*
5	Mesophytic chamerophytes	*Schismatoglottis*
6	Lithopytes	*Schismatoglottis* *Piptospatha*
7	Rheophytes	*Schismatoglottis* *Piptospatha*
8	Chasmophytes	*Schismatoglottis* *Piptospatha*
9	Hemicryptophytes	*Hapaline*
10	Geophytes	*Amorphophallus*
11	Inland	*Homalomena*
12	Estuary	*Aglaodorum*
13	Amphibious	*Cryptocoryne*
14	Hydrohemicrypto-phytes	*Pistia*
15	Hydrotherophytes	*Lemnoideae*

(Source: Boyce and Wong, 2013)

2.2 Genus Alocasia

Alocasia is a genus which has 100 species of herbaceous, laticiferous,diminutive to gigantic and usually robust herbs (Boyce, 2008). Plants of this genus are rhizomatous or bulbous perennials with large heart-shaped leaves and *Alocasia* species is detected based on ornamentals among plant collectors and landscape gardeners which is based on their foliar charm, patterns of leaf variegation and texture, as well as tolerance to limited sunlight (Bhatt *et al.*,2013)

The *Alocasia* habitat mostly at the uperhumid lowland forest and only a few species grow at 1000 m altitude or in light-gaps, clearings, or secondary vegetation (Boyce, 2008). The distribution of *Alocasia* is shown in Figure 2.1 :

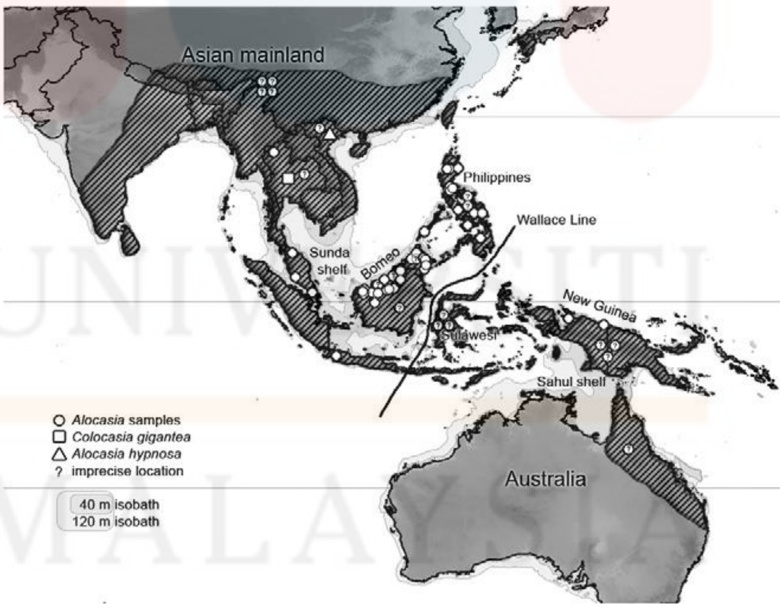

Figure 2.1: The map of distribution of Alocasia

(Source: Nauhimer *et al.*, 2012)

In vegetative and floral structure, the stem of *Alocasia*, typically of most Araceae, is a physiognomically unbranched sympodium and the number of foliage leaves per plant is variable between and within species and individuals, but during flowering episodes in some species it may be reduced to one (Boyce, 2008). Boyce and Wong (2015) mentioned that in the sterile state almost all *Alocasia* species have conspicuous waxy glands in the axils of the primary veins on the abaxial surface of the leaf. Almost the species has the rhizome produces at or below soil level a number of short to rarely greatly elongated, slender, branched or unbranched stolons terminating in more or less globose tuberules (Boyce, 2008).

For their ecological perspectives, their primary and secondary perhumid to ever-wet subtropical, broadleaf tropical forests, predominantly in the lowlands, extending from sea level to lower and mid-montane zones, a few species occurring in open swamps and many *Alocasia* species are locally endemic limestone obligates (Boyce and Wong, 2015).

Alocasia is always cofounded with *Colocasia*. Boyce and Wong (2015) mentioned that *Alocasia* may be readily distinguished from *Colocasia* by its bimodular synflorescence subunits. They also mentioned that inflorescence multiplication in *Colocasia* is achieved in such a way that the whole synflorescence is equivalent to one bimodular unit in *Alocasia* where the inflorescence terminating the vegetative module has only one further inflorescence in the axil of its subtending cataphyll in *Alocasia*.

2.3 *Alocasia longiloba* Miq.

Alocasia longiloba Miq. is the one of the species of *Alocasia.* This species is very widespread at Borneo and Peninsular Malaysia and it intergrades with *A. lowii*, which typically has broader leaf blades and is generally lithophytic on limestone (Boyce, 2008). This plant mostly grows on shady, moist and high humus content area such as at edge of the forest and bush areas (Latif *et al*., 2015). It is also known as 'keladi candik' or 'keladi canek' (Musa *et al.*, 2009).

The description of *Alocasia longiloba* Miq. characteristics is described in Table 2.2. Figure 2.2 shows the leaf of *Alocasia longiloba* Miq. and Figure 2.3 shows the illustration of *Alocasia longiloba* Miq

Table 2.2: Characteristics of *Alocasia longiloba* Miq.

No	Characteristics	Elaboration
1	Stem	-Rhizomatous, generally elongate, erect to decumbent and often No completely exposed sometimes swollen and sub-tuberous
2	Leaves	Solitary,occasionally up to 3 together, subtended by conspicuous lanceolate papery membranaceoous and purplish-tessellate cataphylls degrading to papery fibres
3	Petioles	30–120cm long,sheathing in the lower ca $^{1}/_{4}$ or less, glabrous, purple-brown to pink to green, often strikingly obliquely mottled chocolate brown.
4	Lamina	Pendent, hastatosagittate, rather narrowly triangular, dark to very dark green, usually with the major venation grey-green adaxially, and abaxial surface either green or flushed purple. Secondary venation- initially widely spreading, then deflected towards the margin. Interprimary collective veins- weakly formed and zig-zag at widely obtuse angles.
5	Inflorescences	Solitary to paired, up to 4 pairs in succession without interspersed foliage leaves
6	Peduncle	Resembling petioles, erect at first, then declinate, elongating and then erect in advanced fruit.
7	Spathe	Abruptly constricted Limb- Lanceolate, canoe-shaped and longitudinally incurved Lower spathe- Ovoid to subcylindric, green; limb lanceolate, canoe-shaped and longitudinally incurved

Table 2.2: Characteristics of *Alocasia longiloba* Miq (continued)

8	Spadix	Shorter than to subequalling the spathe Ovaries- subglobose Male flower subcyndirical
9	Fruiting spathe	Ovoid, glossy green.
10	Fruits	Globose-ellipsoid,green, ripening orange-red.

(Source: Boyce, 2008)

Figure 2.2: The leaves of *Alocasia longiloba* Miq.

Figure 2.3.:The illustration of *Alocasia longiloba* Miq.

(Source:http://plantillustrations.org/ILLUSTRATIONS_HD/320423.jpg)

Usually, this ornamental plants uses for treating skin diseases. *Alocasia longiloba* Miq. has been used medicinal plant to treat diseases such as insect bites, antidiarrhea, antidiabetic, antioxidant and antibacterial (Payum *et al.*, 2014; Das and Teron, 2014;Das *et al.*, 2012; Karim *et al.*, 2014; Islam *et al.*, 2013). Latif *et al.*, (2015) mentioned in their research that the *Alocasia longiloba* Miq. stem juice showed remarkable wound healing activity and have a beneficial influence on the various phases of wound healing like fibroplasia, wound contraction and collagen synthesis resulting in faster healing process.

2.4 Propagation of Araceae

Hatono *et al.*, (1991) investigate cultivation on clonally propagated *Pinellia ternata*. In their research, they used tuber of *Pinellia ternata* as a medium propagation. The tubers were cultivated in a pot containing sand in the phytotron and kept at 15˚C, 20˚C, 25˚C and 30˚C for three months. They also mentioned that smaller tubers were cultivated at a higher planting density with an application of a higher amount of fertilizer, the tubers grew rapidly in size. Application of this research for this study might be questionable. This is because this research used the clonally propagated *Pinellia ternate*, which is its tuber characteristics different with *Alocasia longiloba* Miq. tubers. Additionally, this research used the fertilizers for the propagation for different sizes of tubers which is small, medium, large. Possibility of this tubers can growth without fertilizers still unknown.

Fajinmi (2014) in his research uses corms, cormels and split corms of *Xanthosoma mafafa* as a medium propagation. The soil used in this research was a sandy loam texture, slightly acidic to neutral and fertile with average climatic temperature of 27˚C. From the research, it shows that corms, cormels and split corms also give the positive feedback where all the medium propagation growth with the all condition that mentioned above. However, this research uses *Xanthosoma mafafa* corms, cormels and split corms as a medium propagation which its characteristic different with *Alocasia longiloba* Miq. tubers.

2.5 Growth Performance

According to Hatono *et al.*, (1991), they found that the effect of temperature on the growth of *Pinellia ternata* where 25°C appeared to be the most favourable due to the weight of fresh tuber harvested is higher than other temperature. For the temperatures slightly lower than 25°C was more effective for more quantity of tubers harvesting. Among the parameter that they used to determine the growth cultivation of *Pinellia ternate* are number of leaves, initial weight of the tubers (g), average number of leaves, number of tubers flowered, average fresh weight of the tubers (g) , and total fresh weight of harvested tubers (g). Besides that, they also found that small sized tubers with fertilizers shows higher growth rate compared to large and medium sized of tubers and proved that smaller tubers that were cultivated at a higher planting density with an application of a higher amount of fertilizer, the tubers, grew rapidly in size.

Atu (2014) in his research found that the large tuber of sweet potato of *Ipomoea batatas* Lam. has the higher value of thickness of sprout, sprout number and sprout length for both Beauregard and Nothern Star aultivar. This research use the small, small-medium, medium, and large sized tuber to determine the effect of size tuber of both cultivar in the production of sweet potato.

Hailemichael & Resfage (2008) investigate the effect of seed rhizomes size in the growth, yiled, and economic return of *Zingiber officinale* Ros. In their research, they use four different sizes of rhizomes which is small, medium, large and very large. They used weight to differentiate the size of rhizomes which is small (R-4g), medium (R-8g), large (R-16g). and very large (R-32g). Among the parameter they use to determined the growth of *Zingiber officinale* Ros. is the number of tiller, number of leaves, plant height and stem diameter. In their research , they found that very large rhizomes shows the highest the value of plant height, number of leaves, and stem diameter of plant. From their research, they concluded that the very large seed rhizome produced the hight growth rate and yield production.

Desta & Tsegaw (2008) investigate the effect of removal of buds and younger leaves on growth, tuber yield and quality of potato (*Solanum tuberosum* Lam.) . In their research, they used potato tuber that with buds (normal), tuber with removal of terminal buds, tuber with removal of terminal buds and younger leaves, tuber with removal of terminal and axillary buds removed, and tuber with removal of terminal buds, axillary buds and younger leaves removed. In this research, they found that the tuber without buds shows the lower value in plant height compared to normal tuber, but high in yield production especially the tuber with removal of terminal buds, axillary buds and younger leaves.

Ilyas *et al.* (2016) conduct a research about a growth, yield and quality of ginger from produced through early senescence. In their research, they used seed rhizomes that contain buds. In their research, they obtained that ginger with buds that age 8 month after planting produce the best growing which its has the heighest value for all parameter used in this research. The parameter used in this research is plant height, number of tillers, stem diameter, and number of leaves.

Asl (2016) investigate the effect of density and inflorescence removing on yield and yield components of potato (*Solanum tuberosum* Lam.). In his research, he used potato tuber with inflorescence and tuber with removal of inflorescence for growth, yield production and density. The obtained results indicated that florescence removing and density had a significant effect on tuber size, tuber weight, number of leaves, number of branches and tuber yield.

CHAPTER 3

METHODOLOGY

The tubers of *Alocasia longiloba* Miq. divided into two categories based on their size and budding. Fresh weight of the tubers, circumference of tubers, and the height of tubers were recorded for both treatment. Size of the tubers categorized into three which were small, medium, and large. The budding categorizes into two which were tuber with budding and tubers without budding. After that, the tubers were planted into polybag with 1:1 ratio of top soil and cocoa peat. Growth rate of the tubers for both treatment were observed and recorded for 2 month durations.

3.0 Material

For this study, the tubers were collected at Kampung Dusun Buluh which is located at Machang, Kelantan. The latitude was 5° 53' 19.7808" N and the longtitude was 102° 11' 29.202" E.

3.1 Experiment details

3.1.1 Study location

This study was conducted in nursery site which located at the back of faculty which neared with husbandary lab and tissue culture lab in UMK Jeli campus.The site was already set up with paranet

3.1.2 Nursery Technique

As mentioned earlier, tubers categorized into two which was sizes and budding. For budding categories, small size was choosen for both treatment based on the reference (Hatono *et al*., 1991) and it was assumed the small size was the best size choice for budding comparison. All treatment planted through polybag of ratio 1:1 of top soil and cocoa peat. For each treatment, 10 plants with three replication were planted. For sizes categories, it was used RCBD (Randomized Completed Block Design) where each block contain each replication of sizes tubers to reduce the experimental error and bias. The parameter that used to measured the growth rate for of the tubers described in the Table 3.1.

Table 3.1: Parameter of *Alocasia longiloba* Miq.

Parameters	Methods
Plant height (cm)	From the soil collar until the tip of plants using metre ruler
Diameter of plant (cm)	Measure the diameter of the stem using digital vernier calliper
Number of leaf	Determined the number of leaf

3.1.3 Experimental Design

In this study, there are three treatment that used which is small tuber (S), medium tuber (M), and large tuber (L). Hatono *et al*., (1991) in their research used weight to differentiate the characteristics of tubers which was large (0.79 g), medium (0.30 g) and small (0.08 g).

Atu (2014) in his research categorized the tuber of *Ipmoea Batatas* (L.) which was large, medium, small-medium, and small at their own range which is described in table 3.2:

Table 3.2 : Categorization tuber sizes of *Ipmoea Batatas* (L.)

Size	Measurement and Weight		
	Diameter (mm)	Length (cm)	Weight (g)
Small	20-50	20-170	65-110
Small-medium	50-75	175-210	230-325
Medium	75-100	240-280	450-980
Large	100-150	300-400	990-2170

Source: Atu (2014)

Hailemichael & Tesfaye (2008) also categorized the rhizome of *Zingiber officinale* Ros. which was small, medium, large, and very large at their own range which is described in Table 3.3:

Table 3.3 : Categorization rhizomes size of *Zingiber officinale* Ros.

Size	Measurement and Weight		
	Diameter (mm)	Length (cm)	Weight (g)
Small	2.3	<3.0	4.0
Medium	3.4	3.1-6.0	8.0
Large	4.1	6.1-9.0	16.0
Very Large	4.8	>9.0	32.0

Source: Hailemichael & Tesfaye (2008)

For this study, the weight also used to differentiate the sizes of tubers but it was added with circumfrences and the height of the tubers to separate the collected tubers into three differences sizes. Each treatment consits 10 plants and three replication for each size and the total plants is 150 for tuber sizes treatment. Each block consits of replication each sizes which replication 1, replication 2, replication 3. Table 3.4 shows the sizes of tuber characteristics, Figure 3.1 show the small sized tuber, Figure 3.2 show the medium sized tuber, Figure 3.3 show the large sized tuber , and Figure 3.4 show the layout of the plant under paranet net for sizes treatment.

Table 3.4: Sizes of tuber characteristics

Size	**Circumfrences**	**Height**	**Weight**
Small (S)	< 9 cm	< 8 cm	< 19 g
Medium (M)	< 11 cm	< 11 cm	< 30 g
Large (L)	≥ 11 cm	≥ 11 cm	≥ 30 g

Figure 3.1 Small tuber of *Alocasia longiloba* Miq

Figure 3.2 Medium tuber of *Alocasia longiloba* Miq

Figure 3.3 Large tuber of *Alocasia longiloba* Miq

Block of replication 1

S1R1	M2R1	L3R1
L10R1	S8R1	S5R1
M5R1	L1R1	L4R1
S7R1	M6R1	M5R1
M1R1	S9R1	S2R1
L5R1	M10R1	M3R1
S3R1	S4R1	S10R1
M8R1	M9R1	M4R1
L1R1	L2R1	L6R1
S6R1	M7R1	L9R1

Block of replication 2

L3R2	S1R2	M2R2
S5R2	L10R2	S8R2
L4R2	M5R2	L1R2
M5R2	S7R2	M6R2
S2R2	M1R2	S9R2
M3R2	L5R2	M10R2
S10R2	S3R2	S4R2
M4R2	M8R2	M9R2
L6R2	L1R2	L2R2
L9R2	S6R2	M7R2

Block of replication 3

M4R3	L1R3	S7R3
L2R3	M6R3	S1R3
S4R3	L7R3	M5R3
L8R3	S2R3	M1R3
M7R3	S8R3	L4R3
S3R3	M2R3	L5R3
L6R3	S9R3	M3R3
M8R3	L9R3	S5R3
L10R3	M10R3	S10R3
S6R3	L3R3	M9R3

(S:Small, M:Medium, L:Large, R:Replication)

Figure 3.4 Layout of the plant under paranet net for sizes treatment

3.1.4 Budding treatment

For this treatment, two tuber which is budding and without budding was planted where they consits of 10 plant with 3 replication for each condition. They planted through polybag contain cocoa peat and top soil which same as tuber sizes treatment. As mentioned earlier, small sizes was choosen for this treatment to measured growth rate for budding and without budding tuber. Figure 3.5 shows the budding and without budding tuber and Figure 3.6 shows the layout of experiment.

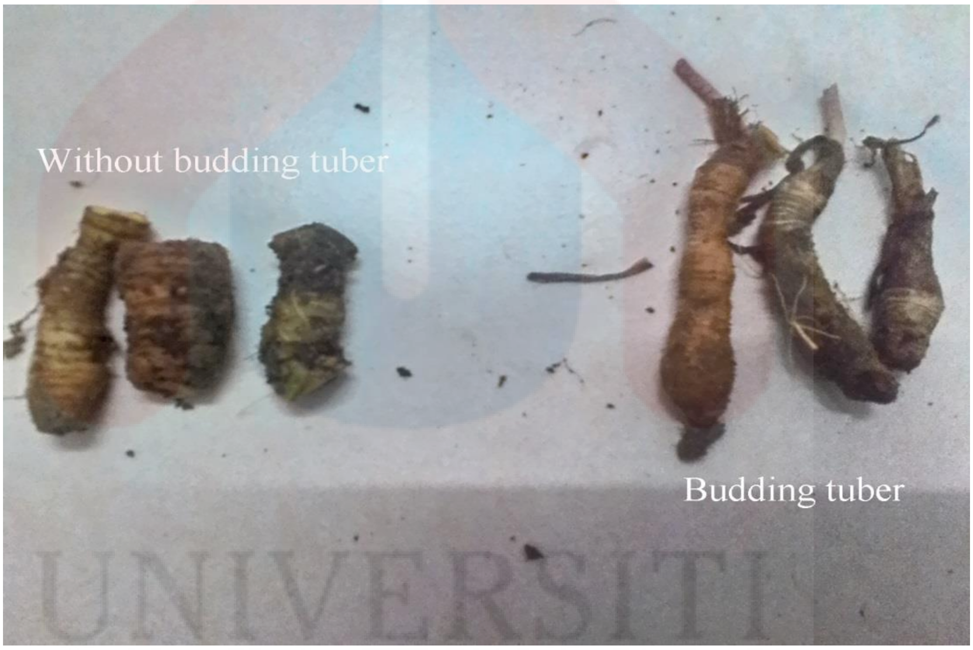

Figure 3.5 Budding and without budding tuber

Layout for Budding

Bd1	Bd11	Bd21
Bd2	Bd12	Bd22
Bd3	Bd13	Bd23
Bd4	Bd14	Bd24
Bd5	Bd15	Bd25
Bd6	Bd16	Bd26
Bd7	Bd17	Bd27
Bd8	Bd18	Bd28
Bd9	Bd19	Bd29
Bd10	Bd20	Bd30

Layout for Without Budding

WBd1	WBd11	WBd21
WBd2	WBd12	WBd22
WBd3	WBd13	WBd23
WBd4	WBd14	WBd24
WBd5	WBd15	WBd25
WBd6	WBd16	WBd26
WBd7	WBd17	WBd27
WBd8	WBd18	WBd28
WBd9	WBd19	WBd29
WBd10	WBd20	WBd30

(Bd:Budding, Wbd:Without Budding)

Figure 3.6: Layout of the plant under paranet net for budding treatment

3.2 Data Analysis

In this study, SPSS 20.0 used to analysed data. For sizes treatment, a nonparametric tests known as Kruskal-Wallis Test was conducted to compare the growth parameter ; the plant height, diameter of the stem, and number of leaves since when it tested with Kolmogorov–Smirnov test to determined the normality of the data, it is not significanlly (P >0.05) which is not normal. For the budding treatment, another nonparametric test which was Mann-Whitney Test was conducted to compare the growth parameter ; the plant height, diameter of the stem, and number of leaves as its already tested with Kolmogorov–Smirnov test to determined the normality of the data, it is not significanlly (P >0.05) which is not normal.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Plant Growth Parameter (Height)

4.1.1 Differences mean values between tuber sizes (Height)

Figure 4.1 showed the graph of plants height of three tuber sizes which is small, medium and large. From the graph, it can see that the height of plants increase per week. There was no growing plants from week 1 for all tuber sizes. However, at week 2, the medium tuber start to growth. Large tuber start to growth at week 3 and small tuber size start to growth at week 5. From the graph showed that large tuber has the highest mean value of plant height. Figure 4.1 also shows that all tuber has the highest reading at week 8.

A Kruskal-Wallis Test showed that there was no significance difference between this three size of tubers at week 8 where (P >0.05). The Kruskal-Wallis Test is enclosed in Appendix A (A.1).

Eventhough medium tuber was the fastest growth among the tubers, large tuber grew the higher shoot than the small and medium tuber. However, number of plants that grew from small tuber is higher than large and medium tuber. Tubers are storage organs of plants and it has large masses of parenchyma that contain mainly water and starch grains (Leon, 1977). Since the large tuber has the large storage for the nutrient required by a plant and supplied the hight nutrient for the growth of the plant. Since it has satisfied nutrient which influences the plant to growth rapidly. It is a major cause why the height of the plant from this tuber is higher compared to medium and small size tuber.

Hailemichael & Tesfaye (2008) revealed in their research show the very large rhizomes of *Zingiber officinale* Ros has the highest value for the plant height compared to large, medium, and small size which is similar to the result that obtained above. Atu (2014) also showed the similiarity result where the large tuber of sweet potato of *Ipmoea Batatas* (L.) Lam showed the highest sprout compared to medium, small-medium, and small sizes of the tuber.

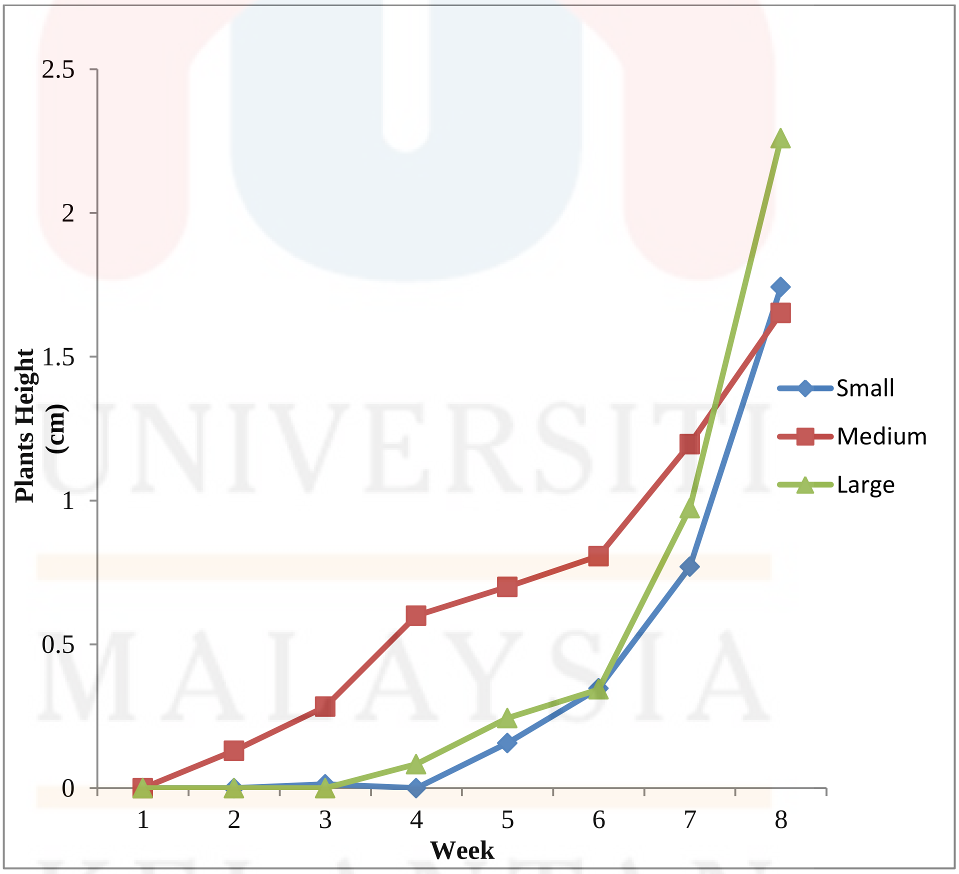

Figure 4.1:The height plants of small, medium, and large tuber

4.1.2 Differences mean values between buddings treatment (Height)

Figure 4.2 showed the graph of plants height of two kind of tubers which is budding tuber and without budding tuber. At week 3, the budding tuber start to growth its shoot while without budding tuber start to growth its shoot at week 4. From the graph showed that budding tuber has the highest mean value of plant height. The mean value of budding tuber is 1.86 cm while without budding is 0.11 cm. Figure 4.2 shows that all tuber has the heighest reading at week 8.

A Mann-Whitney Test showed that there was significance difference between this two kind of tubers from at week 8 where (P <0.05). The Mann-Whitney Test is enclosed in Appendix A (A.4) .

The result above showed that budding tuber has higher growth rate than without budding. Since the budding contain the mini shoot, possibly it can growth faster than a without budding because the without budding tuber may take a time to them to growth the shoot. For budding tuber itself, its number of plant grew from it also higher than without budding tuber.

Similiar to Desta & Tsegaw (2008) where in their research, the potato of (*Solanum tuberosum* L.) which its buds removed from the tuber shows the lower plant height compared to the tuber with budding. This is attributed to the direct effect of removal of the growing tip which is the buds and the reduction in stem elongation and increased partitioning of assimilates to the tubers due to reduced gibberellic acid synthesis activity (Desta & Tsegaw, 2008). Gibberellic acid play an important role in stimulate cell division and extension in buds

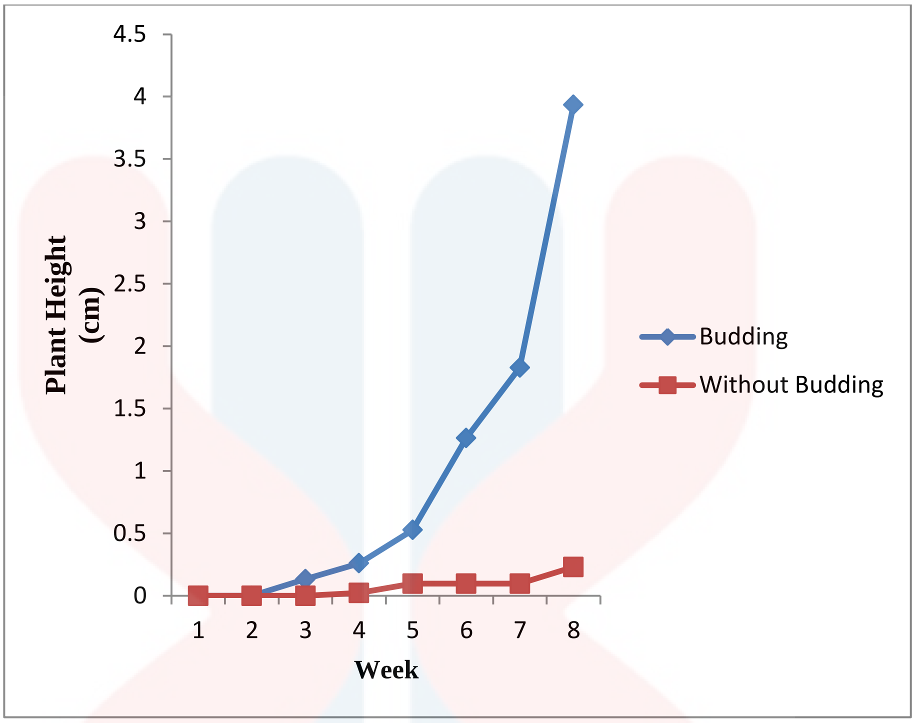

Figure 4.2:The height plants of budding and without budding tuber

4.2 Plant Growth Parameter (Diameter of plants)

4.2.1 Differences mean values between sizes

Figure 4.3 showed the plants diameter of three tuber sizes which is small, medium and large. From the graph showed that large tuber has the highest mean value of plant diameter. The mean value of large tuber is 0.83 mm while medium is 0.8 mm and small tuber is 0.78 mm. Figure 4.1 shows that all tuber has the highest reading at week 8.

A Kruskal-Wallis Test also shows that there was no significance difference between this three size at week 8 where (P >0.05) .The Kruskal-Wallis Test is enclosed in Appendix A (A.2).

Same like height parameter, large tuber grew the higher shoot than the small and medium tuber and they also have the biggest diameter of the stem. Eventhough the plant that grew from small tuber is higher than large and medium tuber, but the medium size tuber have the bigger diameter of the stem compared the small tuber which grew the plant in small scale of the diameter. As mentioned previous discussion, Leon (1977) states that storage organs of plants and it has large masses of parenchyma that contain mainly water and starch grains. Since large tuber has large storage of nutrient, its give the nutrient to the buds to growth bigger include its stem. It is contribute to the diameter reading of this plant. However, statistics proves there was no significance differences of the diameter of the plants to all sizes of the tuber.

Atu (2014) in his research also obtained the similar result. The large tuber of sweet potato of *Ipmoea batatas* (L.) also shows the highest diameter or thickness of sprout compared to medium, small-medium, and small sizes of the tuber. Hence, its shows that large tuber contribute to the height reading of plant diameter.

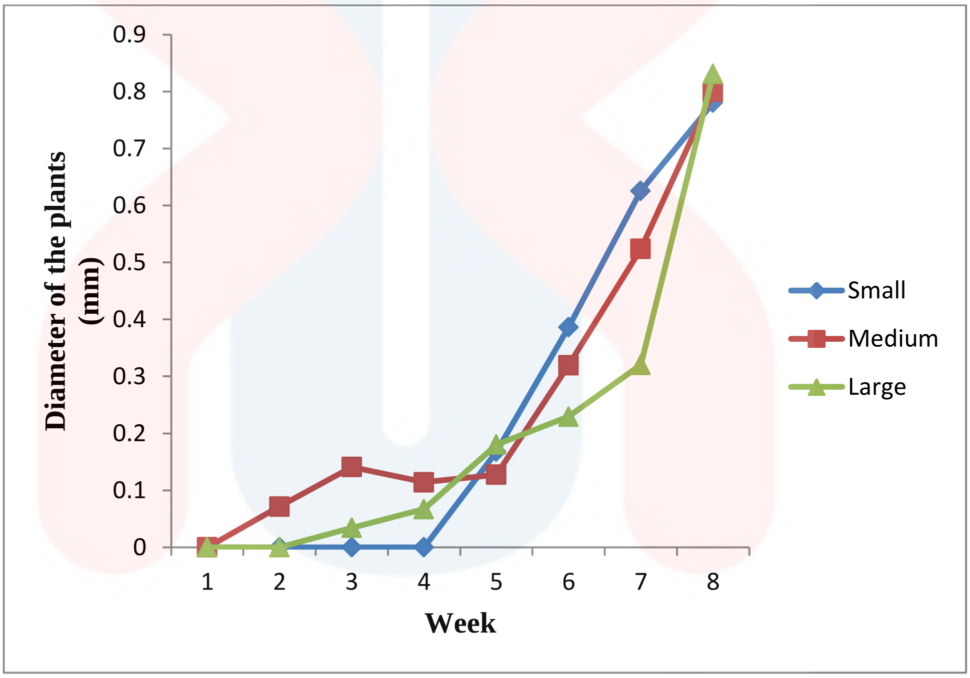

Figure 4.3:The plants diameter of small, medium, and large tuber

4.2.2 Differences mean values between buddings treatment

Figure 4.4 showed the plants diameter of two kind of tubers which is budding tuber and without budding tuber. From the graph showed that budding tuber has the highest mean value of plant diameter. The mean value of budding tuber 3.93 mm while without budding is 0.11 mm.Figure 4.2 shows that all tuber has the highest reading at week 8.

A Mann-Whitney Test showed there was significance difference of plant diameter between this two kind of tubers where (P<0.05). The Mann-Whitney Test is enclose in Appendix A (A.5).

The result above showed that budding tuber has higher growth rate than without budding which is same as previous result. Its number of plant grew from it also higher than without budding tuber. The diameter of the stem for both tuber still in same scale, the only differences is the number of plant that live and grews from the tubers itself that become main contribution to the data that obtained above as without budding take a longer duration to growth the buds.

Ilyas *et al.* (2016) also show the similar result as mentioned above. Ilyas *et al.* (2016) found that the ginger rhizomes of *Hedychium coronarium* also produced the highest diameter of the plant. From that, it can be conclude the tuber with budding also produce the highest diameter plant compared to without budding.

.

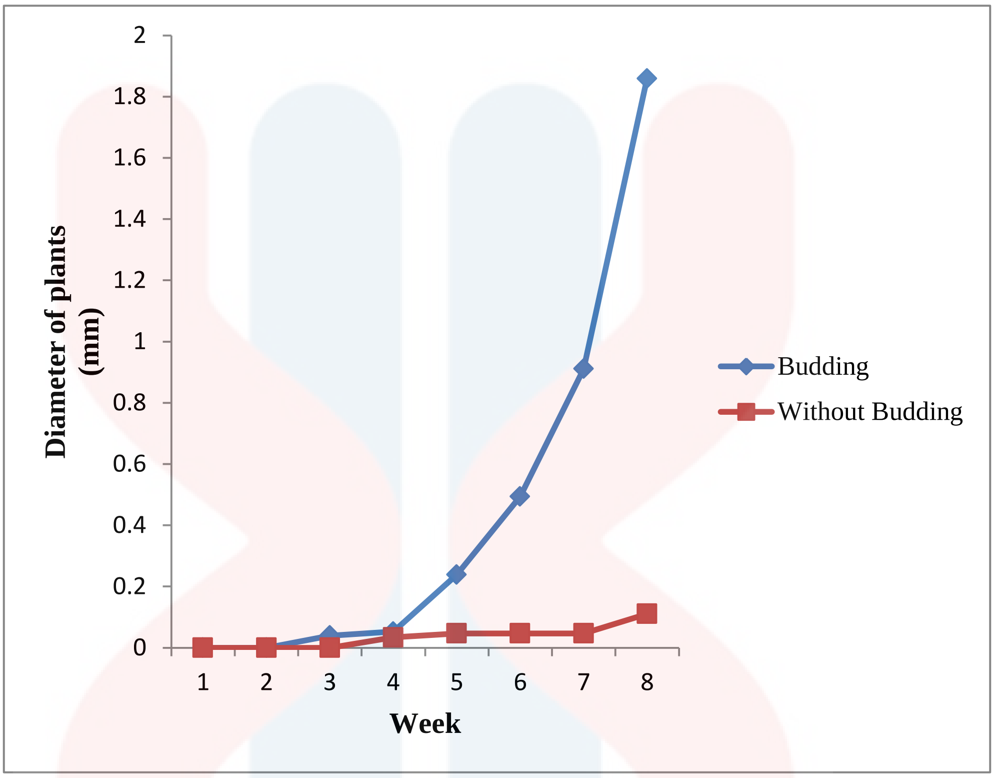

Figure 4.4:The plants diameter of budding and without budding tubers

4.3 Plant Growth Parameter (Number of leaf)

4.3.1 Differences values between sizes

Figure 4.5 showed the number of leaves of three tuber sizes which is small, medium and large. The data was measured from week 1 to week 8 after planting. From the graph showed that small tuber has the highest value of number of leaves. The value of small tuber is 5 while medium and large tuber is 3. Figure 4.5 shows that all tuber has the heighest reading at week 8.

Same with the previous result, a Kruskal-Wallis Test shows there was no significance difference between this three size of tubers in term of number of leaf (P>0.05). A Kruskal-Wallis Test is enclosed in Appendix A (A.3) .

For this parameter, small tuber produce the higher number of leaf than the medium and large tuber. As mentioned in the previous result, large tuber has the highest mean value for height of the plant and diameter of the plant. However, the plant from the large tuber did not produce the leaf yet, same goes with the medium tuber. Since the small tuber has the small storage of the nutrient, its required the nutrient to keep it alive. The leaf produced from the small tuber generate photosynthesis and give the nutrient to the small tuber and plant itself compared to large tuber which has large storage nutrient to them. Unfortunately, statistics also proves there was no significance differences of the number of leaf to all size of tuber.

Hailemichael & Tesfaye (2008) in their research revealed the similar result where the small size rhizome shows that the highest number of leaves for the first year of the propagation. Hence, it can said that the small tuber produce the leaf faster than large and medium tuber.

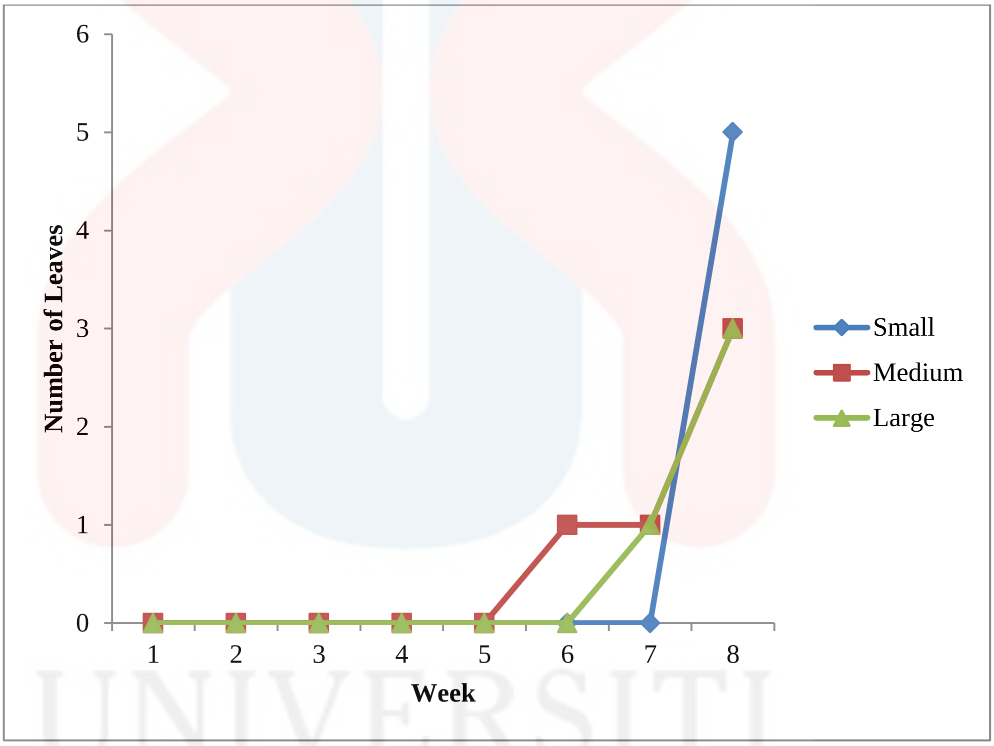

Figure 4.5:The leaf number small, medium, and large tuber

4.3.2 Differences values between buddings treatment

Figure 4.4 showed the number of leaves of two kind of tubers which is budding tuber and without budding tuber. From the graph showed that budding tuber has the highest value of number of leaves. The value of budding tuber is 14 while without budding is 1.

A Mann-Whitney Test shows there was significance difference between this two kind of tubers (P<0.05). The Mann-Whitney Test is enclosed in Appendix A (A.6).

The budding tuber grew the fastest plant and also the leaf production. Mini shoot within the budding tuber quite play a vital role so that the plant grew faster. As already mentioned previous result, without budding take a longer duration to growth the plant and also production of the leaf since the bud removed, gibberellic acid did not play its role in stimulate cell division and extension in buds (Desta & Tsegaw, 2008).

Sarmadnia & Koochaki (1993) indicates that the removal of the buds can increase the number of leaves and stem. This is support by Asl (2016) when his research found that the removal of inflorensence of potato tuber (*Solanum tuberosum* L.) show the heighest number of leaf produced. Different with the result obtained from this study where the number of leaf produced came from budding tuber heigher than without budding tuber. Ilyas *et al.* (2016) in their research also shows the number of leaves produced from the rhizomes tuber with buds is height, especially 8 month after planting.

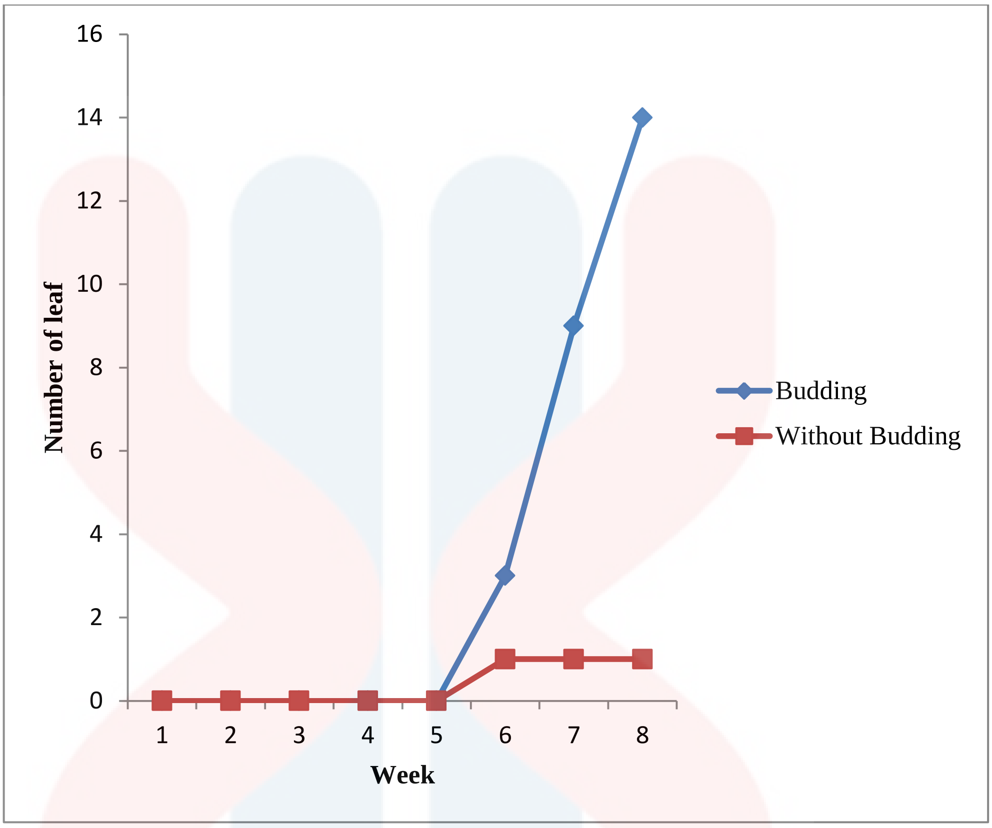

Figure 4.6:The number of leaf of budding and without budding tubers

4.4 External Factor

The result is also influenced by several factors. First is the weather. The weather be considered the factor that influences the growth rate. Start from week 1 to week 4, the weather was hot and dry, which effect the growth rate of this plants. But, when it cames to week 6 to week 8 which the weather was rainy and cold, the plant start to growth steadily. From that, it can said that this tuber favour for cold and humid environment. Hatono *et al.*, (1991) also proved that 25°C appeared to be the most favourable to weight of fresh tuber harvested in higher scale than other temperature and also the number of leaves produces also higher in this temperature than other temperature which is similar with to result that obtained from the previous discussion where the number of leaf increase when it comes to week 6 to week 8 which the weather was rainy and cold.

Next factor that can be considered is the moisture of the soil. From week 1 to week 4, the soil within the polybag was overwatering that might effect the nutrition of the soil itself. This plant favoured grows on shady and moist soil (Latif *et al.*,2015). Over moisture soil will definitely effect the growth of the tubers.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Two objectives which have been outlined in the first chapter have been done successfully by the end of this study. First, the growth of *Alocasia longiloba* Miq. tuber for three different sizes which is small, medium, and large have been observed from this study. Secondly, the growth performance of *Alocasia longiloba* Miq. have investigated through its varity of tubers. From this study, it can concluded that the larger tuber size has the highest value for the height of plant and diameter of the plant than medium and small tuber while small tuber has the highest number of plant and number of leaves produced than larger and medium size tuber. Besides that, the budding tuber showed the highest growth rate and the number of plant than without budding tuber.

5.2 Recommendation

Since this study focused only the growth parameter; number of leaves, plant heights, and plant diameter, this study can be continued by researching other growth parameter such as, pH. temperature, soil moisture contents, fertilizers, and others. Besides that, this study can be more beneficial where it can measured growth performance of seeds of *Alocasia longiloba* Miq. than compared with the growth perfomances of the tubers.

References

Asl, A. N. (2016). The effect of density and inflorescence removing on yield and yield components of potato (Solanum tuberosum L.) . *International Journal of Advanced Biotechnology and Research (IJBR)*, 21-28.

Atu, L. L. (2014). Studies on propagation materials and growing conditions

Bhatt, A., Stanly, C., & Keng, C. L. (2013). In vitro propagation of *Alocasia* species. *Horticultura Brasileira*, *31*(2), 210-215.

Bilgin, A., Kilinc, M., Kutbay, H. G., Yalcin, E., & Huseyinova, R. (2009). Effects of sexual reproduction on growth and vegetative propagation in *Arum macultum* L. Araceae: in situ removal experiments .*Pol. J. Ecol*, *57*(2), 261-268.

Boyce, P. C. & Wong, S. Y(2015). Compendium genera Aracearum malesianum. Aroideana, 38, 40-177.

Boyce, P. C. (2008). A review of *Alocasia* (Araceae: *Colocasieae*) for Thailand including a novel species and new species records from South-West Thailand. *Thai Forest Bulletin (Botany)*, *36*, 1-17.

Boyce, P.C.,& Yeng, W. S. (2013). The Araceae of Malesia I: Introduction. *The Malayan Nature Journal*, 64(1).

Das, C., Teron, R., (2014). Ethnobotanical notes of the Rabha community in Mataikhar reserve forest of Kamrup district, Assam, India. Res. *J. Recent Sci.* 3 (6), 26‑33.

Das, P.R., Akter, S., Islam, M.T., Kabir, M.H., Haque, M.M., Khatun, Z., Nurunnabi, M., Khatun, Z., Lee, Y.K., Jahan, R., Rahmatullah, M., (2012). *A selection of medicinal plants used for treatment of diarrhea by folk medicinal practitioners of Bangladesh*. American-Eurasian J. Sustain. Agric. 6 (3), 153–161

Desta, B., & Tsegaw, T. (2008). The Effect of Removal of Buds and Younger Leaves on Growth, Tuber Yield and Quality of Potato (Solanum tuberosum L.) Grown Under Hot Tropical Lowland. *East African Journal of Science*, *2*(2), 124-129.

Hailemichael, G., & Tesfaye, K. (2008). The effects of seed rhizome size on the growth, yield and economic return of ginger (*Zingiber officinale* Rosc.). *Asian Journal of Plant Sciences*.

Hatano, K., Shoyama, Y., & Nishioka, I. (1991). Cultivation Studies on Clonally Propagated *Pinellia ternata*. *Pharmacology journal*, *45*(3), 203-205.

Ilyas, S., Palupi, E. R., & Susila, A. D. (2016). Growth, Yield and Quality of Ginger from Produced through Early Senescence. *International Journal of Applied*, *6*(1).

Islam, M.K., Mahmud, I., Saha, S., Sarker, A.B., Mondal, H., Monjur-Al-Hossain, A.S.M., Anisuzzman, M., (2013). Preliminary pharmacological evaluation of Alocasia indica Schott tuber. J. Integr. Med. 11 (5), 343-351.

Karim, M.R., Ferdous, N., Roy, N., Sharma, S.C.D., Jahan, M.G.S., Shovon, M.S., (2014). A study on antidiabetic activity of the leaf and stem of *Alocasia indica L*. in steptozotocin induced diabetic rats. Int. J. Biosci. 5 (6), 195-202

Latif, M. A., Zaki, M. Z. M., Leng, T. M., Rahman, N. H. A., Arshad, S. A., & Hamid, A. (2015). *Alocasia denudata* Engler treatment enhance open wound healing activities in Wistar rat's skin. *Journal of ethnopharmacology*, *176*, 258-267.

Leon, J. (1977). Origin, evolution, and early dispersal of root and tuber crops [tropics]. In *4. Symposium of the International Society for Tropical Root Crops. Cali (Colombia). 1 Aug 1976.*

Mansor, M., Boyce, P. C., Othman, A. S., & Sulaiman, B. (2012). *The Araceae of Peninsular Malaysia (Penerbit USM)*. Penerbit Usm.

Musa, Y., Azimah, A.K., Zaharah, H., (2009). Tumbuhan Ubatan Popular Malaysia..Malaysian Agricultural Research and Development Institute, Malaysia (MARDI).

Nauheimer, L., Boyce, P. C., & Renner, S. S. (2012). Giant taro and its relatives: a phylogeny of the large genus Alocasia (Araceae) sheds light on Miocene floristic exchange in the Malesian region. *Molecular Phylogenetics and Evolution*, *63*(1), 43-51.

Payum, T.,Das, A.K., Shankar, R., (2014). Nutraceutical folk food plants used among indigenous people of east siang district of Arunachal Pradesh, India. Am. J. Pharmtech. Res. 4 (4), 696-704.

Sarmadnia, Gh. H., Koochaki, V., (1993), Physiology of Crop Plants (Translation), *Mashhad University Press, P. 468*

Zulhazman,Hamzah Peter C. Boyce, and Mashhor Mansor. "Studies on Homalomeneae(Araceae) of Peninsular Malaysia IV: Homalomena stongensis, a remarkable new species endemic to Gunung Stong, Kelantan." *Gardens' Bulletin Singapore 64.2 (2012): 525-529.*

Appendices

Appendix A: The Kruskal-Wallis Test (Plant Height)

Ranks

	Size	N	Mean Rank
Height	small	30	45.87
	medium	30	42.43
	large	30	48.20
	Total	90	

Test Statistics[a,b]

	Height
Chi-Square	1.187
df	2
Asymp. Sig.	.552

a. Kruskal Wallis Test

b. Grouping Variable: Size

Appendix B: The Kruskal-Wallis Test (Diameter of plants)

Ranks

	Sizes	N	Mean Rank
Diameter	small	30	46.27
	medium	30	43.73
	large	30	46.50
	Total	90	

Test Statistics[a,b]

	Diameter
Chi-Square	.332
df	2
Asymp. Sig.	.847

a. Kruskal Wallis Test

b. Grouping Variable: Sizes

Appendix C: The Kruskal-Wallis Test(Number of leaves)

Ranks

	sizez	N	Mean Rank
leaves	small	30	47.50
	medium	30	44.50
	large	30	44.50
	Total	90	

Test Statistics[a,b]

	leaves
Chi-Square	.819
df	2
Asymp. Sig.	.664

a. Kruskal Wallis Test

b. Grouping Variable: sizez

Appendix D: The Mann-Whitney Tests Test (Height of the plants)

Ranks

	Budding	N	Mean Rank	Sum of Ranks
Height	Budding	30	40.07	1202.00
	Without Budding	30	20.93	628.00
	Total	60		

Test Statistics[a]

	Height
Mann-Whitney U	163.000
Wilcoxon W	628.000
Z	-4.913
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Budding

Appendix E: The Mann-Whitney Tests Test (Diameter of plants)

Ranks

	Budding	N	Mean Rank	Sum of Ranks
Diameter	Budding	30	40.07	1202.00
	Without Budding	30	20.93	628.00
	Total	60		

Test Statistics[a]

	Diameter
Mann-Whitney U	163.000
Wilcoxon W	628.000
Z	-4.913
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Budding

Appendix F: The Mann-Whitney Tests Test (Number of leaf)

Ranks

	budding	N	Mean Rank	Sum of Ranks
leaves	budding	30	37.00	1110.00
	withoutbudding	30	24.00	720.00
	Total	60		

Test Statistics[a]

	leaves
Mann-Whitney U	255.000
Wilcoxon W	720.000
Z	-3.843
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: budding

Appendix G: Kulmogorv normality table (Sizes tuber and budding tuber)

Tests of Normality

	Block	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Height	1.00	.263	30	.000	.748	30	.000
	2.00	.523	30	.000	.357	30	.000
	3.00	.428	30	.000	.482	30	.000

a. Lilliefors Significance Correction

Tests of Normality

	Budding	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Height	Budding	.539	30	.000	.180	30	.000
	Without Budding	.539	30	.000	.180	30	.000

a. Lilliefors Significance Correction