# THE GROWTH OF KAPUR TANDUK (*Dryobalanops lanceolata* Burck.) ON DIFFERENT LEVELS OF CANOPY OPENING AND FERTILIZATION

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Bogor, June 2017

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# ABSTRAK

RIZKI MARDHATILLAH. Pertumbuhan Kapur Tanduk (*Dryobalanops lanceolata* Burck.) pada Tingkat Keterbukaan Kanopi dan Pemupukan yang Berbeda. Dibimbing oleh PRIJANTO PAMOENGKAS dan DARWO.

Upaya rehabilitasi lahan kritis dalam kawasan hutan maupun areal bekas penebangan merupakan kegiatan yang penting untuk dilakukan. Jenis Dipterocarpaceae merupakan kelompok jenis yang potensial untuk dikembangkan dalam pemulihan areal hutan terdegradasi, salah satunya adalah kapur tanduk (*Dryobalanops lanceolata* Burck.). Tujuan penelitian ini adalah mengetahui pengaruh faktor keterbukaan kanopi, dosis pupuk kandang, dan kondisi fisik lingkungan (suhu, kelembaban, kelerengan, dan kondisi tanah) terhadap pertumbuhan Kapur Tanduk (*D. lanceolata*.) di KHDTK Haurbentes, Jawa Barat. Hasil penelitian menunjukkan perlakuan perbedaan tingkat keterbukaan kanopi (71.34 %, 37.91%) dan dosis pupuk kandang (0, 2, 4 kg/lubang tanam) tidak memberikan pengaruh nyata baik secara tunggal maupun interaksi keduanya terhadap pertambahan diameter dan tinggi anakan *D. lanceolata*. Perbedaan tingkat keterbukaan areal menghasilkan respon yang berbeda pada masa awal pertumbuhan, tingkat keterbukaan 71.24% (areal terbuka) memiliki respon pertumbuhan yang baik terhadap diameter sedangkan pada tingkat keterbukaan 37.91% (dibawah naungan) pertumbuhan tinggi tanaman. Dengan demikian, sampai umur 6 bulan anakan *D. lanceolata* dapat beradaptasi dengan tingkat keterbukaan kanopi antara 37 – 72%. Kondisi lingkungan pada petak penelitian di KHDTK Haurbentes sesuai dengan karakteristik tempat tumbuh jenis tersebut sehingga mampu mendukung pertumbuhan anakan *D. lanceolata*.

Kata kunci: *Dryobalanops lanceolata*, keterbukaan kanopi, pertumbuhan, pupuk kandang.

# ABSTRACT

RIZKI MARDHATILLAH. The Growth of Kapur Tanduk (Dryobalanops lanceolata Burck.) on Different Levels of Canopy Opening and Fertilization. Supervised by PRIJANTO PAMOENGKAS and DARWO.

Critical land rehabilitation efforts in the forest and logged-over areas are important activities to be undertaken. Dipterocarpaceae is a potential species to be developed in the restoration of degraded forest areas, one of which is Kapur Tanduk (Dryobalanops lanceolata Burck.). This study aims to determine the influence of canopy opening factor, dose of manure, and environmental conditions (temperature, humidity, slope, and soil conditions) to the growth of D. lanceolata in KHDTK Haurbentes, West Java. The results showed that difference levels of canopy opening (71.34%, 37.91%) and the dose of manure (0, 2, 4 kg / planting hole) have no significant effect either single or interaction both to the increase in diameter and height of D lanceolata. Different levels of canopy opening in both areas, different responses in the early days of growth, at the level of openness of 37.91% (under the shade) high growth rate of plants. Thus, until the age of 6 months D. lanceolata can adapt to the degree of canopy opening between 37-72%. The environmental conditions in the research plots in KHDTK Haurbentes are consistent with the characteristics of the growing species so as to support the growth of D. lanceolata seedling.

Key words: Dryobalanops lanceolata, canopy opening, growth, manure.

# THE GROWTH OF KAPUR TANDUK (*Dryobalanops lanceolata* Burck.) ON DIFFERENT LEVELS OF CANOPY OPENING AND FERTILIZATION

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An Undergraduate Thesis
to Acquire Bachelor's Degree
in Department of Silviculture

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# PREFACE

Alhamdulillah, all praise and gratitude are only for Allah subhanahu wa ta'ala for all His mercy and guidance, so that the author can complete this scientific work. The theme of this research which has been conducted since February 2017 is the Growth of Horn Lime (Dryobalanops lanceolata Burck.) at Different Levels of Canopy Openness and Fertilization.

On this occasion the author would like to thank Mr. Dr. Ir Prijanto Pamoengkas, MSc FTrop and Dr. Ir Darwo, MSi as supervisors who have provided direction, guidance, motivation, patience, time, experience to the author until the completion of the research and writing of this thesis. All lecturers of the Faculty of Forestry of IPB who have provided useful knowledge for the author, as well as all staff of the Department of Silviculture who have provided facilities and helped and facilitated during the lecture period. In addition, the author's appreciation goes to the Bogor Forestry Research and Development Agency for allowing them to conduct research at KHDTK Haurbentes. The author's deepest gratitude goes to both parents (Sawiruddin and Afifah), Sister (Reisha Astiqomah and Muammar Ridho Assidqy) and big family for all the prayers, love, and moral and material support that has been given so far. Colleagues and mentors Andini Martika R, Steffi Au, and Raden Surya who have helped and provided direction and encouragement to the author. Research Partners M Agus Salim, Andik Suhendi, Fakhri Sukma A who have helped during data collection and provided input in the preparation of this thesis. Friends who have given color during the lectures of the writer Muhammad Firdi, Siti Clarisa Delia, Desi Retnowati, Selvia Triana, Meilani Karina, Andi Sylviah, Darwati, Putri Novita Sari, all friends from the Department of Silviculture and the Faculty of Forestry batch 50 and the Student Association Jambi which cannot be mentioned one by one. as well as the moral and material support provided so far. Colleagues and mentors Andini Martika R, Steffi Au, and Raden Surya who have helped and provided direction and encouragement to the author. Research Partners M Agus Salim, Andik Suhendi, Fakhri Sukma A who have helped during data collection and provided input in the preparation of this thesis. Friends who have given color during the lectures of the writer Muhammad Firdi, Siti Clarisa Delia, Desi Retnowati, Selvia Triana, Meilani Karina, Andi Sylviah, Darwati, Putri Novita Sari, all friends from the Department of Silviculture and the Faculty of Forestry batch 50 and the Student Association Jambi which cannot be mentioned one by one. as well as the moral and material support provided so far. Colleagues and mentors Andini Martika R, Steffi Au, and Raden Surya who have helped and provided direction and encouragement to the author. Research Partners M Agus Salim, Andik Suhendi, Fakhri Sukma A who have helped during data collection and provided input in the preparation of this thesis. Friends who have given color during the lectures of the writer Muhammad Firdi, Siti Clarisa Delia, Desi Retnowati, Selvia Triana, Meilani Karina, Andi Sylviah, Darwati, Putri Novita Sari, all friends from the Department of Silviculture and the Faculty of Forestry batch 50 and the Student Association Jambi which cannot be mentioned one by one. and Raden Surya who has helped and provided direction and encouragement to the author. Research Partners M Agus Salim, Andik Suhendi,

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The author realizes that in writing this thesis there are still many shortcomings, therefore the author appreciates all forms of suggestions and constructive criticism. Hopefully this scientific work will be useful for the development of special knowledge in the field of forestry in Indonesia.

Bogor, June 2017

*Rizki Mardhatillah*

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# INTRODUCTION

## Background

Indonesia's forest area has experienced a lot of depreciation compared to the situation 25 years ago where there were 20 million hectares of forest declared barren caused by various factors, both natural and human actions (Indriyanto 2008). This decline in forest area is also shown by the high rate of deforestation inside and outside forest areas during 2012 2013 of 727 981.2 ha/year (Ministry of Forestry 2014). The impact that has been caused since the intensive exploitation of tropical forests in Indonesia is the emergence of critical land, a decrease in forest productivity and the decreasing number and presence of species that have high commercial value, especially the dipterocarpaceae species group.

Efforts to rehabilitate critical land in forest areas and logged-over areas are activities that must be carried out in order to ensure the forest function as a life support system. In forest rehabilitation efforts, it is very important to select species and know management techniques to determine the right method and according to environmental conditions. Selection of species that are in accordance with the ecological characteristics of the place to grow will cause the stands to grow optimally. Species that are able to grow well at a certain site are one of the factors that determine the success rate of rehabilitation.

The Dipterocarpaceae species are a group of superior target species that have very good prospects for development in the restoration of degraded forest areas. Planting Dipterocarpaceae species such as horn lime (Dryobalanops lanceolata Burck.) can be an option because it is a species that has the potential to be developed. D. lanceolata has the advantage of wood that is resistant to attack by destructive organisms because it contains extractive substances, so this type is classified as a type of wood that is durable and strong and has high economic value. The International Union for Conservation of Nature and Natural Resources (2016) states that D. lanceolata is a tree species of the Dipterocarpaceae family which is included in the endangered category (endangered = EN). Type D development. lanceolata in forest rehabilitation efforts can also maintain the existence of this species from the threat of extinction. This is indicated by the presence of D. lanceolata species in Indonesia which is still limited to several islands, namely Java in the dipterocarp arboretum and Kalimantan in lowland rain forests (Appanah and Turnbull 1998), which are spread in North Kalimantan and East Kalimantan (Sangkulirang and West Kutai). (Sidiyasa 2015). The importance of research related to planting D. lanceolata in different environmental conditions, to see its adaptability and growth in the context of planting activities on critical land. lanceolata in Indonesia which is still limited to several islands, namely Java in the dipterocarp arboretum and Kalimantan in lowland rain forests (Appanah and Turnbull 1998), which are scattered in North Kalimantan and East Kalimantan (Sangkulirang and West Kutai) (Sidiyasa 2015). The importance of research related to planting D. lanceolata in different environmental conditions, to see its adaptability and growth in the context of planting activities on critical land. lanceolata in Indonesia which is still limited to several islands, namely Java in the dipterocarp arboretum and Kalimantan in lowland rain forests (Appanah and Turnbull 1998), which are scattered in North Kalimantan and East Kalimantan (Sangkulirang and West Kutai) (Sidiyasa 2015). The importance of research related to planting D. lanceolata in different environmental conditions, to see its adaptability and growth in the context of planting activities on critical land.

## Problem Formulation

To date, forest rehabilitation activities in Indonesia have not been well planned and have a low success rate. This is due to the type of development factor which generally has difficulty. Thus, it is very important to conduct a study on what factors can support the growth of the selected species and treatment according to their ecological characteristics to increase the value of forest stands both in quality and quantity and to maintain forest sustainability. Based on this description, the authors formulate research problems, namely:

1. How does open canopy affect ability growth of D. lanceolata ?
2. How is the effect of manure application on the growth ability of D. lanceolata?
3. What is the physical condition of the environment in the observation plot? in support the growth of D. lanceolata?

## Purposes of research

This study aimed to determine the effect of canopy openness, manure, and environmental physical conditions (temperature, humidity, slope, and soil conditions) on the growth of D. lanceolata in Special Purpose Forest Areas (KHDTK) Haurbentes, West Java.

## Benefits of research

The results of this study are expected to be a source of information in the form of quantitative data regarding the growth of D. lanceolata on the effect of canopy openness and organic fertilizers in KHDTK Haurbentes as one of the considerations and decision making in sustainable forest management.

## General Condition of Research Site

KHDTK Haurbentes has an area of 105.5 Ha which is geographically located at an altitude of ±250 meters above sea level (asl) with coordinates 6º32' 6º33' South Latitude and 106º26' East Longitude (Center for Research and Development of Forests and Nature Conservation 2005). The research plot is located at coordinates 6º33'23.6" South Latitude and 106º43'47.1" East Longitude. Administratively, KHDTK Haurbentes is included in Haurbentes Village, Jugala Jaya Village and Wirajaya Village, Jasinga District, Bogor Regency. Based on the results of the planimetric measurements on the topographic map, at a macro level, the area is hilly with slightly steep to steep slopes leading to the north, with an average slope of > 16 .

According to the list of wet months and dry months of the Schmidt and Ferguson classifications, KHDTK Haurbentes has a climate type A and belongs to the wet climate category with an average rainfall of 4 276 mm/year. (Center for Research and Development of Forests and Nature Conservation 2005). KHDTK Haurbenets has three types of soil, namely Red Yellow Podsolic, Regosol, and Brown Forest Soil. The research plot is included in the Red Yellow Podsolic soil type. The general properties and characteristics of the three types of soil in general are slow permeability and drainage from obstructed to good. The top to bottom soil layer reacts sourly (pH 4.6) and contains low organic matter, nitrogen, P2O5 and K2O, and the C/N ratio decreases from the top layer to the bottom layer (Center for Research and Development of Forests and Nature Conservation 2005). From 1940 to 2004 at KHDTK Haurbentes 73 types of plants have been planted,

# METHODS

## Time and places

This research activity was carried out in February 2017 in the KHDTK Haurbentes area, Jasinga District, Bogor Regency, West Java.

## Tools and materials

The tools used are ruler, meter, calipers, Spherical densiometer, thermohygrometer, ring sample, clinometer, compass, label paper, clear plastic, machete, camera and laptop equipped with Microsoft Office 2007 and SAS 9.1.3 software. The material used in this study was D. lanceolata saplings at KHDTK Haurbentes.

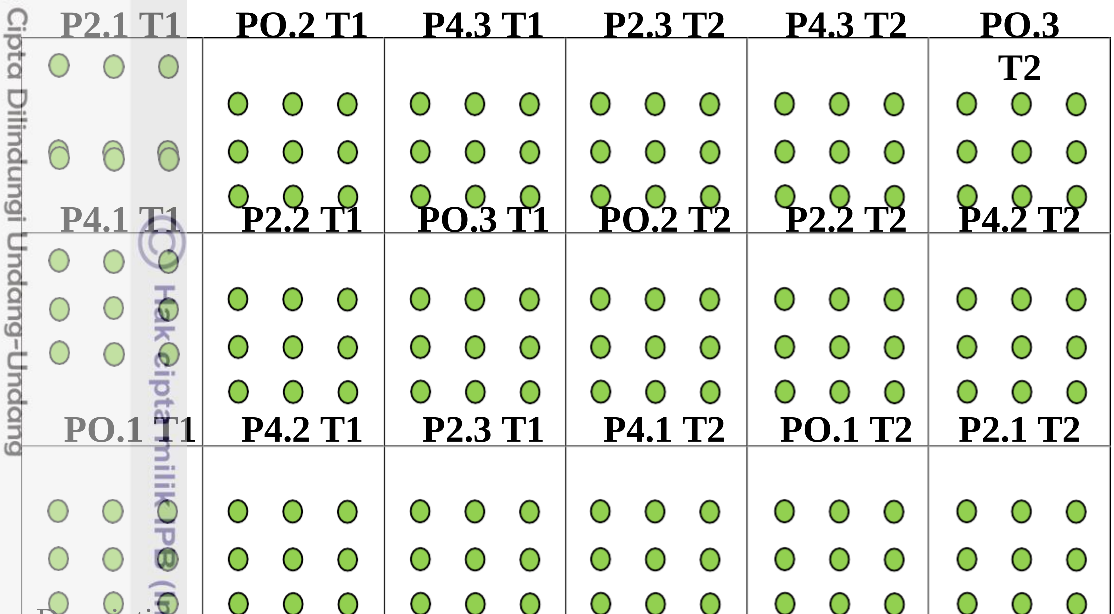
## Research procedure

The data collected in this study are primary data and secondary data. Primary data was collected by collecting data on the growth of D. lanceolata tillers, where the parameters used to see the growth of D. lanceolata seedlings were height, diameter and environmental physical conditions (soil, temperature, humidity, topography). Secondary data used in the form of initial data on diameter and height of D. lanceolata when planting in the research plot as well as other necessary supporting data for research.

### Research Plot Conditions

The study was conducted on D. lanceolata saplings whose seeds were obtained from North Barito Regency, Central Kalimantan and planted in KHDTK Haurbentes in August 2016. The D. lanceolata saplings were divided into two groups, based on the level of openness, namely under stands.

and in open areas. In each group there were differences in the dose of organic fertilizer in the form of manure, namely 0 kg/planting hole as a control, 2 kg/planting hole and 4 kg/planting hole. Figure 1 shows the layout of the D. lanceolata planting plots used as the location for data collection.




Description :

| | | |
|---|---|---|
| T1 | = | Open area |
| T2 | = | Under the shade of the stand |
| P0 | = | Dosage of manure 0 kg/planting hole |
| P2 | = | Dosage of manure 2 kg/planting hole |
| P4 | = | Dosage of manure 4 kg/planting hole |
| (1,2,3) | = | Test |
| ● | | D. lanceolata puppies |

Figure 1 Research plot layout

**Data retrieval**

Data were collected by direct observation and measurement of several parameters, namely height, diameter, percent canopy cover, environmental conditions and soil conditions.

**Height and diameter**. Height and diameter measurements were carried out on all individual D. lanceolata tillers in the observation plot. Height measurement was measured using a tape measure starting from the base of the stem to the point of apical shoot growth, while diameter measurements were carried out using a caliper at a height of 10 cm above ground level.

**Percent Openness of the canopy**. Measurement of canopy openness was carried out in the research plot using a spherical densiometer at 5 points with azimuths of 360o, 90o, 180o, 270o, and center. At each point, the readings with the spherical densiometer are directed in the direction of North, East, South, and West. For each box, the percentage of the sky image that can be caught on a spherical densiometer mirror with fully open weights has a weight of 4 (100%), a weight of 3 (75%), a weight of 2 (50%), a weight of 1

(25 %), and a weight of 0 (no shadow of the sky that can be seen) (Fathurrohmah 2014). The measurement data is recorded on a tally sheet and then calculated on the percentage of canopy openness (Ti) based on Supriyanto and Irawan (2001):

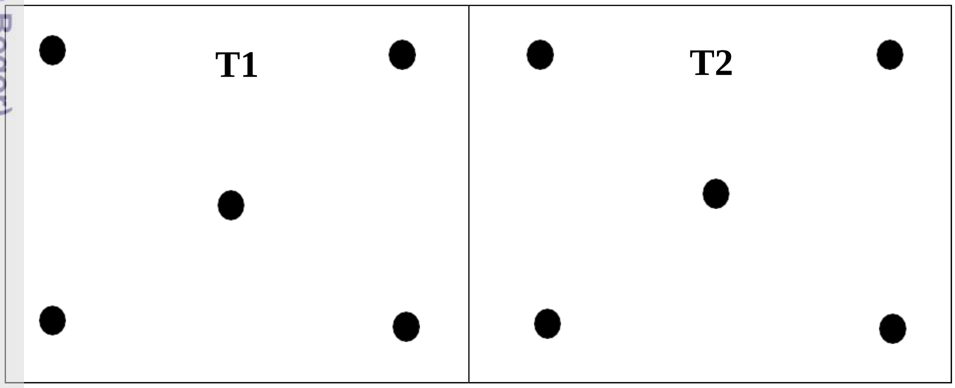
$$i = \frac{T1+T2+T3+\cdots+Tn}{N} \text{ x } 1.04$$

Description:

| | | |
|---|---|---|
| Ti | = | Canopy openness |
| Mr | = | Weight at each measurement point |
| N | = | Number of measurement points |
| 1.04 | = | Correction factor |

**Environmental conditions.** Data on environmental conditions taken in the observation plot includes temperature, humidity and slope. The success of plant life and growth is influenced by various environmental factors, both biotic and abiotic found in the place where it grows (Indriyanto 2000). Thus, it is necessary to observe environmental condition data to determine suitable and supportive growing conditions for D. lanceolata growth. Temperature and humidity measurements were carried out using a thermohygrometer for three consecutive days without rainy days, which were measured in the morning (7.00 08.00), afternoon (12.00 13.00 o'clock) and afternoon (16.00-17.00 o'clock) (Wijayanto and Rhahmi 2013 ). Slope level measurement is measured using a clinometer.

**Soil characteristics**. Soil condition data were used as supporting information on the growth of D. lanceolata tillers. Soil condition data collection (chemical properties and physical properties) was carried out by taking soil samples in two land conditions, namely treatment plots under shade and in open areas. In each land condition, soil samples were taken at five points as shown in Figure 2.




Description :

| | | |
|---|---|---|
| T1 | = | Open area |
| T2 | = | Under the shade of the stand |
| ● | = | Soil sampling location |

Figure 2 Layout of soil sampling in each plot

Soil samples were taken for analysis of chemical properties at a depth of (0−20 cm and 20−40 cm) and were composite results from areas with relatively similar climatic and topographical conditions. Soil samples for analysis of physical properties are taken from a body of soil by minimizing changes or damage to its natural form and are intact soil samples taken using ring samples. The data on the analysis of the physical properties of the soil taken included texture, bulk density and porosity, while the chemical properties of the soil tested were CEC, exchangeable bases (Ca, Mg, K, Na), pH, C-organic, total N. , C/N ratio, P-available and base saturation. The base saturation of the earth shows the ratio between the number of base cations and the number of all cations.

$$\text{Base saturation} = \frac{\text{Number of base cations}}{\text{Kindergarten}} \text{ x } 100\%$$

## Research design

The study used a split plot design which was arranged in the Latin Square Design (RBSL) environmental design. The treatment consisted of two factors, the first was 2 levels for canopy openness and the second factor was three levels for different doses of organic fertilizer (manure) given. The two treatment factors were composed of 6 treatment combinations, each of which was repeated three times so that there were 18 experimental units with 9 units of observation per experimental unit. The main plot is the treatment of differences in canopy openness, namely, under shade and open areas. Sub-plots were treated with fertilizer doses of 0 kg/planting hole, 2 kg/planting hole, and 4 kg/planting hole. The data obtained were then analyzed using a linear model based on Mattjik and Sumertajaya (2006):

$$Y_{ijk} = + i + ik + j + (a\beta)ij + ijk$$

| | | |
|---|---|---|
| $Y_{ijk}$ | = | The value of the observed variable due to factor A level i, factor B level<br>jth and kth repetitions |
| □ | = | General average |
| *i* | = | Effect of treatment of the i-th canopy openness, i=1,2 |
| □$_{ik}$ | = | The random effect of the main tile that spreads normally |
| *j* | = | Effect of treatment dose of manure-j, j=1,2,3 |
| *(aβ)ij* | = | Effect of interaction between canopy openness treatment with manure dosage treatment |
| □$_{ijk}$ | = | Random effect of normally distributed subplot |

## Data analysis

Result data test measurementanalyzed using analysis of variance (ANOVA) with the F test, this analysis was carried out to determine the effect of treatment of the growth of D. lanceolata tillers. Data processing is carried out using Microsoft Excel and SAS 9.1.3 software, if the data analysis results show:

a) P-value > (0.05), then the treatment does not have a significant effect on growth D. lanceolata puppies.
b) P-value < (0.05), then the treatment has a significant effect on growth D. lanceolata puppies.

Data that showed a significant effect on the treatment given were then continued with Duncan's Multiple Range Test further test.

# RESULTS AND DISCUSSION

The effect of the treatment of differences in the level of canopy openness and dose of manure on the observed parameters in the form of diameter and height growth of D. lanceolata tillers could be determined by analyzing variance. The results of the analysis of variance at the 95% confidence interval can be seen in Table 1.

Table 1 Recapitulation of analysis of variance of the effect of canopy openness treatment and fertilization on the growth of D. lanceolata tillers at the age of 6 months after planting

| Treatment | Parameter | |
|---|---|---|
| | Tall | Diameter |
| Canopy openness | 0.1307tn | 0. 3645tn |
| Dosage of fertilizer (cage) | 0.4221tn | 0.8738tn |
| Interactionopencanopix fertilizer | 0.6721tn | 0.9416tn |

Description : The numbers in the table are significant values, tn = treatment has no significant effect on the 95% confidence interval (> (0.05)

The results of analysis of variance (Table 1) showed that the treatment of canopy openness, dose of manure, and the interaction between canopy openness and dose of manure did not have a significant effect on the average growth height and diameter of D. lanceolata tillers at the age of 6 months after planting. . This can be seen from the observed parameter values (height and diameter) orP-value is greater than 0.05 in each treatment combination given. The results of measurements and calculations on the level of canopy openness using a spherical densiometer in open areas and under shade, respectively, showed values of 71.34% and 37.91%. Factors causing the growth response (diameter and height) did not significantly affect the treatment given, presumably due to the influence of other factors simultaneously in the research plot such as the amount of light intensity that was not measured, temperature, humidity, topography, and soil characteristics.

**Effect of Canopy Opening and Fertilization on Dryobalanops lanceolata's Tiller Height Growth**

In this study, the treatment given did not have a significant effect on the average height growth of D. lanceolata tillers. The average growth height can be seen in Figure 3.

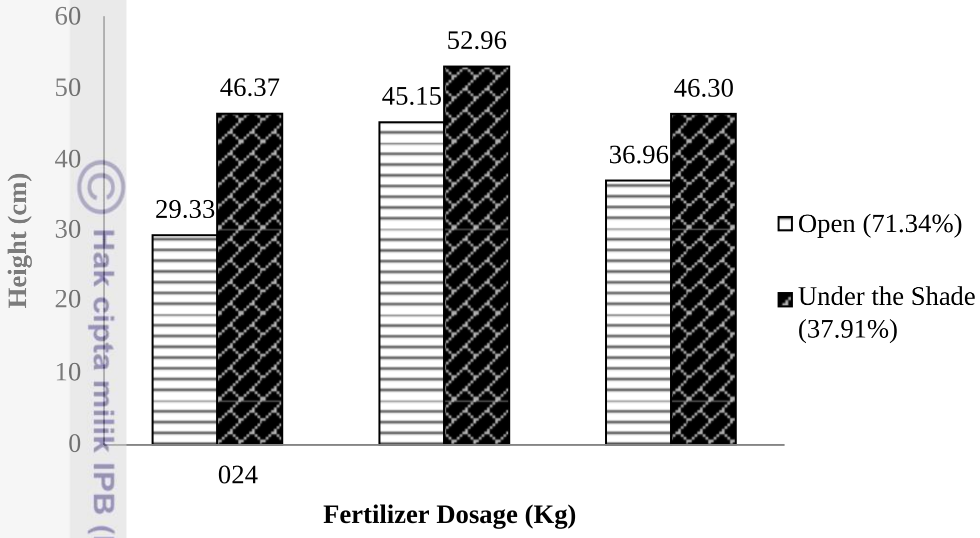



Figure 3 Diagram of the average growth of D. lanceolata tiller height against the treatment of canopy openness and fertilization

Plant height is an indicator of growth that is often observed to determine the effect of the environment and the treatment applied (Sitompul and Guritno 1995). Figure 3 shows that the level of canopy openness (71.34% and 37.91%) and the dose of manure (0, 2, 4 kg/planting hole) gave a response to the increase in the average height growth of D. lanceolata tillers but based on the results of analysis of variance did not show a significant difference, because the range of average values of height growth in the two treatments did not show a significant difference.

The average growth of D. lanceolata tiller height in both areas ranged from 29.33cm – 52.96cm. Another study related to the growth of D. lanceolata saplings was conducted by Omon (2006) on the growth of D. lanceolata on Imperata land with planting land preparation techniques in East Kalimantan, where the average height growth of D. lanceolata was one year after planting. the field ranges from 33.10cm – 56.29cm. This indicates that the average height growth of D. lanceolata tillers in the research plot of the Haurbentes KHDTK which is six months old has a relatively faster growth in height.

Based on the diagram of the average height growth in Figure 3 indicates that D. lanceolata seedlings planted in areas with an openness level of 37.91% or under shade experienced a faster response to increased height growth compared to seedlings planted in areas with an openness level of 71.34%. It is shown with an average height growth value of 52.96 cm. In addition, there is a tendency for a dose of manure 2 kg/planting hole to give a faster growth response than fertilizer doses of 0 and 4 kg/planting hole in areas with low and high levels of openness, although the results of statistical analysis between fertilizer doses were not significantly different.

Canopy openness was an external factor that greatly influenced the growth of D. lanceolata tillers. The level of openness of the canopy will affect the amount of light intensity received by plants, where the smaller the level of openness of the canopy, the smaller the intensity of incoming sunlight. Each plant or tree species has a different tolerance for sunlight, there are plants that grow well in the open, on the other hand there are also plants that can grow well in the shade.

According to Phillips et.al (2002) Dryobalanops spp. is a type of plant with the characteristics of being resistant to shade at the beginning of its growth. Shade-resistant plants have a lower light compensation point than intolerant plants (Lakitan 2008), so that in the early stages of growth, D. lanceolata seedlings planted with low canopy openness (37.91%) tend to grow faster in the vertical direction. (height) to get enough sunlight according to the light compensation point it needs to carry out photosynthesis. This is supported by the results of research by Setiawan et.al (2015) on Shorea leprosula seedlings,

In addition to the openness of the canopy, another external factor that affected the growth of D. lanceolata tillers was the different doses of fertilizer used. Fertilizer is an organic or inorganic material that is applied to the soil with the aim of replacing the loss of nutrients from the soil and improving the physical properties of the soil. The type of fertilizer used in this study was manure from goat manure. The addition of manure into the soil is needed to increase the activity of soil microorganisms, improve soil physical properties and meet plant nutrient needs that cannot be met from the soil to support root development and absorb more nutrients so as to increase plant metabolic processes (Hardjowigeno 2007). ).

Figure 3 shows the application of manure can increase the average height growth of D. lanceolata tillers in areas with a canopy openness of 71.34% and 37.91%, but between the open canopy there is no significant difference from each dose of fertilizer given. Provision of goat manure will affect the increase in the nutrient content of N and K, this is in accordance with the statement of Hardjowigeno (2007) which states that manure from goat manure contains nutrients N and K twice as large as cow manure. Based on the diagram of the average height growth (Figure 3) it also shows that the larger the dose of manure given, the higher the level of lower growth rate, this is presumably because manure from goat manure contains more N nutrients than other types of manure and if this type of fertilizer is used without the right dose it will result in excess N in the soil so that it can cause disturbing soil pollution. plant metabolic processes.

**Effect of Canopy Opening and Fertilization on Diameter Growth of Dryobalanops lanceolata saplings**

The second parameter used to measure growth is plant diameter. The results of analysis of variance conducted to see the effect of treatment on diameter growth (Table 1), showed results that did not significantly affect all treatments and their interactions. The average diameter growth for the given treatment is presented in Figure 4.

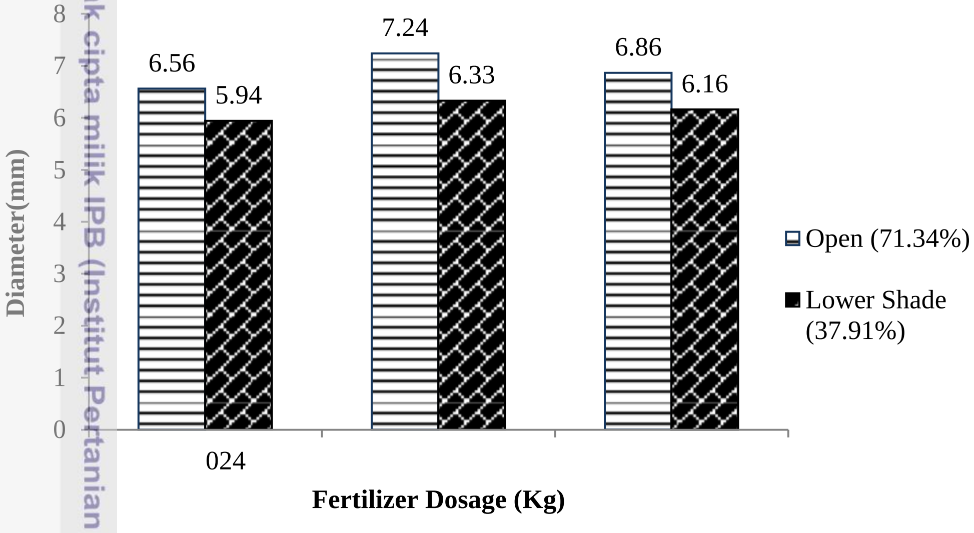



Figure 4 Diagram of the average diameter growth of D. lanceolata saplings to the treatment of canopy openness and fertilization

Pamoengkas (2006) stated that plant productivity can be measured through several parameters, one of which is diameter growth because it has high accuracy and consistency and is easy to implement. Based on Figure 4, it can be seen that the D. lanceolata tillers experienced a relatively stable increase in average diameter growth at both levels of exposure (71.34% and 37.91%), although the differences in values were not significant in each treatment combination. The average diameter growth of D. lanceolata tillers aged 6 months ranged from 5.94mm – 7.24mm. A study of the same type was conducted by Omon (2006) on alang-alang land with planting land preparation techniques in East Kalimantan, the results of this study showed the average tiller diameter of D. one year old lanceolata ranged from 0.30cm – 0.61cm. Based on the above explanation, it was shown that the 6-month-old D. lanceolata at the Haurbentes KHDTK study site had a relatively faster average diameter growth.

Overall the best diameter growth was shown by the combination of treatments in areas with a canopy openness level of 71.34%. Diameter growth is secondary growth that occurs when the needs of photosynthesis for respiration, leaf turnover, roots and height growth have been fulfilled (Lakitan 2008). This indicates that D. lanceolata tillers have the ability to obtain and utilize light effectively for diameter growth in an area with a canopy openness of 71.34% which allows sunlight to enter optimally so that the plant's needs for photosynthesis can be met. In addition to the level of canopy openness, fertilization factors also played a role in the growth of D. lanceolata tillers.

Based on Figure 4 the average diameter growth of D. lanceolata tillers showed an insignificant difference to the dose of manure given (0, 2, and 4 kg/planting hole), where the difference in the average diameter of each dose of fertilizer was 0, 17mm – 0.68mm. The amount of fertilizer given is related to the plant's need for nutrients. Increasing the number of fertilizers given to plants does not guarantee that the plants will grow better, especially if the factors in the soil are not supportive.

Many factors can affect the effectiveness of fertilization in the field such as the level of soil fertility, the method of placing fertilizer, the time of fertilization, the type of fertilizer used for the soil being fertilized and other limiting factors. Most soils only contain 2% – 10% of soil organic matter (Munawar 2011), so the addition of organic matter in the form of manure will have a direct or indirect effect on the availability of plant nutrients to support plant growth. Nutrient content in manure is not too high but this type of fertilizer is able to improve soil physical properties such as soil permeability, porosity, soil structure, water holding capacity and soil cations.

**Environmental Conditions of Research Plot**

Measurement of environmental factors is carried out on several parameters, namely slope, temperature, and humidity. The results of the measurements made can be seen in Table 2.

Table 2 Environmental conditions in the research plot

| **Parameter** | **Location** | |
|---|---|---|
| | **Open area** | **Under the auspices of** |
| Slope (°) | 15-30 | 20-35 |
| Temperature (°C) | 26.6 | 25.1 |
| Humidity (%) | 54.3 | 63.4 |

Environmental factors that can affect plant growth are grouped into environmental factors in the form of soil constituent elements and above-ground factors (Sitompul and Guritno 1995). Environmental conditions on the plot

The research (Table 5) shows that the slope level in the open area is 15° – 30°, while under the shade it is 20° – 35°. In addition, according to the Center for Research and Development of Forests and Nature Conservation (2005), the general condition of the Haurbentes KHDTK is located at an altitude of ±250 meters above sea level (asl). The type Dryobalanops spp. is a plant that is suitable to grow in areas that have flat and wavy topography and at an altitude of 60-400 meters above sea level (Martawijaya et.al 2005).

The next parameters that were measured were temperature and humidity at both levels of openness in the research plot. In general, air temperature and humidity have values that are inversely proportional to where the increasing air temperature will cause lower humidity and vice versa, because air temperature and humidity have a relationship with the intensity of sunlight received. In accordance with Handoko's (1995) statement in Wijayanto and Rhahmi (2013) which states, humidity will be smaller when the air temperature increases and conversely the humidity is higher when the air temperature is lower.

Based on the measurement results, the average daily temperature in the open area is 26.6°C with an air humidity of 54.3%. In the shaded area the average temperature is lower at 25.1°C with a higher humidity of 63.4%. Provision of tree shade has an impact on the intensity of sunlight received in the lower layers, so that it affects the photosynthetic activity that occurs (Wijayanto and Aziz 2013). The optimum temperature for plants to carry out metabolic processes is between 10°C 30°C, at temperatures above or below that temperature, the plant's metabolic rate will decrease (Sugito 2012). Air temperature and humidity affect plants through metabolic processes (photosynthesis, respiration, enzyme activity) that occur in the plant body. Based on the statement above, the temperature in both areas is included in the optimum temperature, which ranges from 25.1°C – 26.6°C, so that it can support plant growth even though it does not show a significant difference in any given treatment combination. In accordance with the statement of Pratiwi et.al (2014) that the requirements for a place for Dryobalanops spp to grow in order to grow optimally are in the temperature range between 20°C – 32°C.

According to Sugito (2012), the response of plants to the optimum temperature varies depending on the type of plant, the type of organ or tissue and the stage of plant growth. This study showed that different levels of area openness resulted in different responses in the early growth period of D. lanceolata tillers, due to differences in the intensity of light received so that it affected the temperature and humidity in each area. Saplings of D. lanceolata planted at the level of openness 71.24% (open area) had a good growth response to diameter, while at the level of openness 37.91% (under shade) plant height growth.

**Soil Characteristics in the Research Plot**

Analysis of the physical and chemical properties of the soil was carried out to determine the nutrient content of the soil contained in the research plot. Soil samples were analyzed at SEAMEO BIOTROP Laboratory. The physical properties of the tested soil include texture, bulk density and porosity, while the chemical properties of the soil tested were CEC, base saturation, pH, C-organic, total N, C/N ratio, available P and exchangeable bases (Ca, Mg, K, Na). ). Soil condition data based on laboratory test results are presented in Table 3.

Table 3 Recapitulation of the results of the analysis of the physical and chemical properties of the soil at the research site

| **Parameter** | **Open area** | | **Under the auspices of** | |
|---|---|---|---|---|
| | **(0cm – 20cm)*** | **(20cm- 40cm)*** | **(0cm – 20cm)*** | **(20cm- 40cm)*** |
| **Soil physical properties** | | | | |
| Fill weight (g/cm3) | 0.82 | - | 0.87 | - |
| Porosity (%) | 67.19 | - | 65.15 | - |
| Texture | | | | |
| Sand (%) | 12.80 | 14.30 | 10.40 | 9.80 |
| Dust (%) | 38.80 | 36.10 | 42.40 | 39.90 |
| Clay (%) | 48.80 | 49.60 | 47.20 | 50.30 |
| **Soil chemical properties** | | | | |
| pH | 5.1M | $5^{M}$ | 5.3M | 5.3M |
| C-Org (%) | 2.14R | 1.76R | 1.87R | 1.53R |
| N total (%) | 0.20R | 0.15R | 0.18R | 0.15R |
| C/N Ratio | 10.7S | 11.7S | 10.4S | 10.2S |
| P-available (ppm) | 9.4SR | 6.6SR | 7.3SR | $6^{SR}$ |
| Languages can be swapped | | | | |
| Ca(meq/100g) | 6.08S | 5.62R | 6.31S | 5.94R |
| Mg (meq/100g) | 2.74T | 2.61T | 2.32T | 2.17T |
| K (meq/100g) | 0.17 R | 0.68T | 0.76T | 0.68T |
| Na | 0.24 R | 0.23 R | 0.21 R | 0.20 R |
| Kindergarten (meq/100g) | 19.15S | 18.41S | 17.39S | 16.22S |
| Saturation base (%) | 51.0 S | 49.6 S | 55.2 T | 55.4 T |

Description : M = Sour, S = Medium, R = Low, SR = Very low, T = High, * = soil depth (Source: Plant Research Staff (1993) in Hardjowigeno (2007))

Soil fertility is related to soil properties (physical, chemical, biological) which can increase the availability of nutrients in the soil so that it has an important role in supporting the growth process. Soil physical properties, especially texture, bulk density and porosity have a role in the plant root system. A good root system will increase the ability of plants to absorb water and nutrients. According to Pamoengkas (2006) soil texture is a soil property that is permanent (inherent) and relatively static. Comparison of the fractions of sand, silt and clay in the two areas showed no significant difference where based on the results of the analysis it can be seen that the soil is dominated by 50% clay, 40% silt, and 10% sand, so the soil texture is silty clay. ).

significant in both areas. The content weight values in both areas ranged from 0.82 – 0.87 g/cm3 while porosity > 60%. The density of the soil has a value that is inversely proportional to the level of soil porosity. The smaller the density of the soil, the greater the total pore space produced, thus supporting the ability of roots to penetrate the soil and transmit water. Good soil will improve soil pore space, aeration (air in the soil) is available quite a lot and causes nutrient absorption to take place optimally (Sugito 2012).

Based on the amount of nutrients needed by plants are divided into macro nutrients and micro nutrients. Macro nutrients are nutrients needed by plants in large amounts (0.1% – 5%) while micro nutrients are nutrients needed in relatively small amounts (< 0.025%) (Munawar 2011). The results of the analysis of soil chemical properties showed that the soil conditions in the research plots had a percentage of nutrients that were not too different, this could be seen from the content of macro and micro nutrients both in open areas and under shade.

Based on the results of the analysis of the chemical properties of the soil (Table 3), it shows that the content of macro nutrients in the form of P (very low) and N (low) in both areas with an average level of soil acidity (pH) in both areas is 5–5.3 (acidic). ). Harjowigeno (2007) stated that acidic soil conditions will cause P elements cannot be absorbed by plants because they are bound by Al. Low N content can be caused by many factors, such as acidic soil conditions causing slow destruction of organic matter and high levels of rainfall causing N in the form of nitrate to be easily leached (Harjowigeno 2007). In addition, another factor is the low supply of organic matter because the vegetation cover is dominated by sengon stands with small leaves and sparse canopy.

One of the properties of organic matter that is important for increasing soil organic matter content is the content of carbon (C) and nitrogen (N) or what is often referred to as the C/N ratio (Munawar 2011). The value of C/N ratio has a relationship with the effect of these materials on the availability of N for plants and the rate of decomposition that occurs. The results of the analysis showed that the C/N ratio in the research plot was in the medium category. Medium C/N ratio indicates that the material contains relatively the same C/N so that the rate of decomposition is hampered and affects the C-organic content in the soil.

Other soil chemical properties such as CEC and base saturation in both areas indicated that the CEC value of the soil was 16.22 – 19.15 (medium) with base saturation values in open areas ranging from 49.6 – 51.0 (moderate) and 55.2 – 55.4 (high). Base saturation shows the ratio between the number of base cations (Ca, Mg, K, Na) and the soil CEC (Harjowigeno 2007). Basic cations are generally easily leached and have low value categories. Overall, the soil in the research plot had a moderate to high base saturation value, this indicates that the soil has not been leached a lot. Kindergarten

Soil has a very close relationship with the level of soil fertility, because it is related to the ability of the soil to absorb and provide nutrients. Assessment of soil fertility status was analyzed using soil fertility assessment criteria from the Soil Research Center (PPT) which refers to soil CEC status, base saturation value, organic matter content, and available P (Rahmi and Biantary 2014). The results of soil chemical analysis (Table 3) which were carried out and associated with the criteria for assessing the fertility status of the chemical properties of the soil showed that the chemical fertility status of the soil in the research plots, both in open and under shade areas, was low. However, based on the results of the research conducted, the soil characteristics in the research plot at KHDTK Haurbentes are thought to have been in accordance with the characteristics of the placegrowtype *D.lanceolata* in the field so as to be able to support growth of D. lanceolata tillers in the research plot. Pratiwi et.al (2014) stated that the characteristics of the place where Dryobalanops spp. in order to grow and develop properly, namely in well-drained soil conditions with light-heavy textures, and acid-neutral soil pH. D. lanceolata is a species belonging to the dipterocarpaceae group. In general, the dipterocarp group does not require high growth conditions because it is able to grow in soil conditions that have good to poor drainage and on soils that are poor in nutrients (Appanah and Turnbull 1998).
contains a lot of clay (Fajri 2008).

# CONCLUSIONS AND SUGGESTIONS

## Conclusion

The treatment of differences in the level of canopy openness (71.34%, 37.91%) and the dose of manure (0, 2, 4 kg/planting hole) did not have a significant effect either singly or interacting with both diameter and height growth of D. lanceolata tillers. Differences in the level of openness of the area resulted in different responses in the early growth period, the openness level of 71.24% (open area) had a good growth response to diameter, while at the level of openness 37.91% (under shade) plant height growth. Thus, until the age of 6 months D. lanceolata tillers can adapt to a canopy openness level between 37-72%. The environmental conditions in the research plot at KHDTK Haurbentes were in accordance with the characteristics of the place where this species grew so that it could support the growth of D. lanceolata tillers.

## Suggestion

Suggestions that can be given from the results of this study are the need for further research on the growth of D. lanceolata tillers at various levels of canopy openness (0%, 25%, 50% ,75%, 100%) and doses other manure. Adding observation parameters to determine the growth characteristics of D. lanceolata tillers. In addition, regular maintenance is needed by giving other types of fertilizers, namely inorganic fertilizers such as NPK to determine the effect of adding inorganic fertilizers to the growth of D. lanceolata tillers.

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Appendix 1 Results of Analysis of Variety on Growth (Diameter and Height) of D. lanceolata tillers aged 6 months

**Fingerprint Analysis of Average Diameter Growth**

| Source | DF | Type I SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Shade | 1 | 2.93627222 | 2.93627222 | 0.92 | 0.3645 |
| r (shade) | 4 | 3.14431111 | 0.78607778 | 0.25 | 0.9033 |
| Fertilizer | 2 | 0.87190000 | 0.43595000 | 0.14 | 0.8738 |
| Shade*fertilizer | 2 | 0.38521111 | 0.19260556 | 0.06 | 0.9416 |

**High Growth Average Variety Print Analysis**

| Source | DF | Type I SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Shade | 1 | 637.4830222 | 637.4830222 | 2.84 | 0.1307 |
| r (shade) | 4 | 184.8610889 | 46.2152722 | 0.21 | 0.9282 |
| Fertilizer | 2 | 432.7658111 | 216.3829056 | 0.96 | 0.4221 |
| Shade*fertilizer | 2 | 187.8668778 | 93.9334389 | 0.42 | 0.6721 |

Appendix 2 Results of Analysis of Chemical and Physical Properties of Research Plots

**Soil Chemical Properties Analysis Results**

Sample : Soil (total 4)/ routine analysis
Sampling location : KHDTK Haurbentes, Jasinga – Bogor Regency
Laboratory received date : February 2017

| No | Sample Code | pH (1:1) H2O | pH (1:1) KCL | C-org W&Black (%) | N Total Kjeldahl (%) | C/N ratio | P Bray I (ppm) | Exchangeable bases (Extract- NH4Acetate 1.0 pH 7.0 (meq/100 grams) Ca | Mg | K | Na | □ | Kindergarten Meq/ 100gr | Base Saturation (%) | Al/H interchangeable Meq/100 gr Al | H | Texture 3 fractions (%) Sand | Dust | clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | T1 (0-20cm) | 5.1 | 4.3 | 2.14 | 0.20 | 10.7 | 9.4 | 6.08 | 2.74 | 0.71 | 0.24 | 9.77 | 19.15 | 51.0 | 1.02 | 0.73 | 12.8 | 38.4 | 48.8 |
| 2 | T1 (20-40cm) | 5.0 | 4.2 | 1.76 | 0.15 | 11.7 | 6.6 | 5.62 | 2.61 | 0.68 | 0.23 | 9.14 | 18.41 | 49.6 | 1.24 | 0.82 | 14.3 | 36.1 | 49.6 |
| 3 | T2 (0-20cm) | 5.3 | 4.4 | 1.87 | 0.18 | 10.4 | 7.3 | 6.31 | 2.32 | 0.76 | 0.21 | 9.60 | 17.39 | 55.2 | 0.95 | 0.82 | 10.4 | 42.4 | 47.2 |
| 4 | T2 40 cm) | 5.3 | 4.5 | 1.53 | 0.15 | 10.2 | 6.0 | 5.94 | 2.17 | 0.68 | 0.20 | 8.99 | 16.22 | 55.4 | 1.31 | 0.69 | 9.8 | 39.9 | 50.3 |

Description :

T1 : Open Area ( openness 71.34% )
T2 : Covered Area ( 37.91% openness )

## Results of Analysis of Soil Physical Properties

| | | |
|---|---|---|
| Sample | : | Land (total 4) |
| Sampling location | : | KHDTK Haurbentes, Jasinga – Bogor Regency |
| Laboratory received date | : | February 2017 |

| No | Location | Parameter | | |
|---|---|---|---|---|
| | | Water content (%) | Filling Weight $(g/cm^3)$ | Porosity (%) |
| 1 | T1 – U1 | 80.39 | 0.77 | 69.12 |
| 2 | T1 – U2 | 65.08 | 0.87 | 65.26 |
| 3 | T2 – U1 | 83.22 | 0.79 | 68.44 |
| 4 | T2 – U2 | 58.64 | 0.95 | 61.87 |

Description :

T1 : Open Area ( openness 71.34% )
T2 : Covered Area ( 37.91% openness )
U1 : 1st replay
U2 : 2nd test

# BIOGRAPHY

The author was born in Jambi on April 2, 1996 as the eldest of three children of the couple Sawiruddin and Afifah. The author completed his education at SMA Negeri 4 Jambi City in 2013 and in the same year the author passed the selection to enter the Bogor Agricultural Institute (IPB) through the National Selection for State Higher Education Entrance (SNMPTN) and was accepted at the Department of Silviculture, Faculty of Forestry.

While studying at IPB, the author was active in various committees and organizations. In 2013 – 2014 the author was active as a member of the management of the Jambi Student Association (HIMAJA) Bogor. In 2014 – 2015 the author was active as secretary II at the Tree Grower Community Professional Association (TGC) and a member of the Pathology Group. In the following year 2015-2016 the author was still active in the TGC Professional Association as Secretary I and a member of the Forest Nutrition Group. In addition, the author has been a committee member of the 2014 Silviculture Cup as a member of the Documentation and Decoration Publication (PDD) division, The 8th TGC In Action (TIA) in 2015 as a member of the consumption division and BELANTARA in 2015 as a member of the medical division.

The author has carried out field practices and activities, including Forest Ecosystem Introduction Practice (PPEH) in Cilacap – Baturaden (2015), Forest Ecosystem Introduction Practice (PPH) in Gunung Walat Educational Forest (HPGW) Sukabumi (2015) and Professional Work Practice (PKP) ) at Perum Perhutani KPH Semarang, Central Java (2016).

As one of the requirements for obtaining a forestry degree from IPB, the author completed a thesis entitled "Growth of Horn Lime (Dryobalanops lanceolata Burck.) at Different Levels of Canopy Openness and Fertilization" under the guidance of Dr. Ir Prijanto Pamoengkas, M.Sc F.Trop and Dr. Ir Darwo, M.Si.