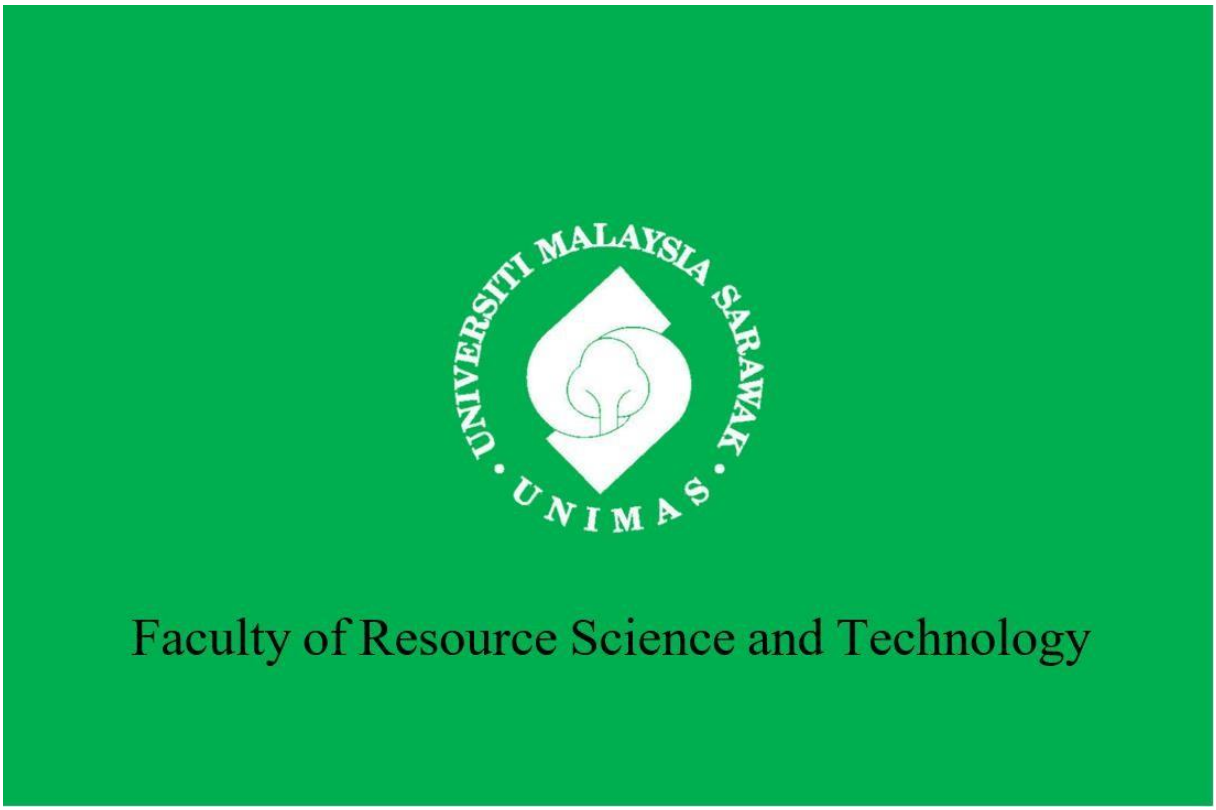

Vegetative Propagation of *Bucida molineti* (Spiny Bucida) via Stem Cutting

CHARLENE JOY ANAK CLEVELAND (72765)

Bachelor of Science with Honours
(Plant Resource Science and Management)
2022

Vegetative Propagation of *Bucida molineti* (Spiny Bucida) Via Stem Cutting

CHARLENE JOY ANAK CLEVELAND

A thesis submitted in partial fulfilment of the Requirement of the Degree Bachelor of Science with Honours in Plant Resource Science and Management

Supervisor: Dr. Hashimah Elias

Plant Resource Science and Management

Faculty of Resource Science and Technology
University Malaysia Sarawak
2022

DECLARATION

UNIVERSITI MALAYSIA SARAWAK

Grade: _____

Please tick (√)

Final Year Project Report	☑
Masters	☐
PhD	☐

DECLARATION OF ORIGINAL WORK

This declaration is made on the July day of 14 year 2022

Student's Declaration:

I CHARLENE JOY ANAK CLEVELAND (72765) FACULTY OF RESOURCE SCIENCE & TECHNOLOGY (PLEASE INDICATE NAME, MATRIC NO. AND FACULTY) hereby declare that the work entitled, Vegetative Propagation of Bucida molineti via Stem Cutting is my original work. I have not copied from any other students' work or from any other sources with the exception where due reference or acknowledgement is made explicitly in the text, nor has any part of the work been written for me by another person.

14 July 2022
Date submitted

Charlene Joy Anak Cleveland (72765)

Supervisor's Declaration:

I, DR. HASHIMAH ELIAS (SUPERVISOR'S NAME), hereby certify that the work entitled, Vegetative Propagation of Bucida molineti via Stem Cutting (TITLE) was prepared by the aforementioned or above mentioned student, and was submitted to the "FACULTY" as a * partial/full fulfillment for the conferment of Bachelor of Science in Plant Resource Science & Management (PLEASE INDICATE THE DEGREE TITLE), and the aforementioned work, to the best of my knowledge, is the said student's work

Received for examination by: _____ Date: 14 July 2022
(Dr. Hashimah Elias)

I declare this Project/Thesis is classified as (Please tick (√)):

☐ **CONFIDENTIAL** (Contains confidential information under the Official Secret Act 1972)*
☐ **RESTRICTED** (Contains restricted information as specified by the organisation where research was done)*
☑ **OPEN ACCESS**

I declare this Project/Thesis is to be submitted to the Centre for Academic Information Services (CAIS) and uploaded into UNIMAS Institutional Repository (UNIMAS IR) (Please tick (√)):

☑ **YES**
☐ **NO**

Validation of Project/Thesis

I hereby duly affirmed with free consent and willingness declared that this said Project/Thesis shall be placed officially in the Centre for Academic Information Services with the abide interest and rights as follows:

- This Project/Thesis is the sole legal property of Universiti Malaysia Sarawak (UNIMAS).
- The Centre for Academic Information Services has the lawful right to make copies of the Project/Thesis for academic and research purposes only and not for other purposes.
- The Centre for Academic Information Services has the lawful right to digitize the content to be uploaded into Local Content Database.
- The Centre for Academic Information Services has the lawful right to make copies of the Project/Thesis if required for use by other parties for academic purposes or by other Higher Learning Institutes.
- No dispute or any claim shall arise from the student himself / herself neither a third party on this Project/Thesis once it becomes the sole property of UNIMAS.
- This Project/Thesis or any material, data and information related to it shall not be distributed, published or disclosed to any party by the student himself/herself without first obtaining approval from UNIMAS.

Student's signature _____ (14 July 2022)

Supervisor's signature: _____ (14 July 2022)

Current Address:
Kampung Tarat Mawang, 94700 Serian, Sarawak.

Notes: * If the Project/Thesis is **CONFIDENTIAL** or **RESTRICTED**, please attach together as annexure a letter from the organisation with the date of restriction indicated, and the reasons for the confidentiality and restriction.

[The instrument was prepared by The Centre for Academic Information Services]

ACKNOWLEDGEMENT

First and foremost, I would like to thank God for His continuous mercies and wisdom in finishing this final year project thesis.

I also want to thank my fantastic supervisor, Dr. Hashimah Elias, for her superb advice, guidance, compassion, and support from the beginning to the end of this project.

Thank you very much to all of my supporting and helpful friends especially Chriscynthia Bridgitte Lumat, Nur Shamimi Izzati, Syed Zulhakimi, Jenny Sima James, Gery Carson Noden, Treavor Roma, Matelda De Avesha, Flora Bah and Selvana Eyra Felix for your compassion and friendship.

Finally, and most importantly, I would like to thanks my wonderful and supporting family, my parents, Mr. Cleveland Raden and Madam Elizabeth Lunsa, who provided financial support, love, and prayers during the entire process of studying and learning at UNIMAS until I can complete this project. They always told me that I could achieve whatever I set in my mind to and never let a good lesson go unlearned.

Vegetative Propagation of *Bucida molineti* (Spiny Bucida) Via Stem Cutting

Charlene Joy Anak Cleveland

Plant Resource and Management
Programme Faculty of Resource
Science and Technology
University Malaysia Sarawak

ABSTRACT

Bucida molineti belongs to Combretaceae family is an ornamental plant that is well-known for its majestic and architectural structure. It is commonly known as spiny bucida, spiny black olive and dwarf geometry tree which illustrate its unique characteristics. The aesthetic beauty of its canopy with wide-spreading branches provides more shade while the presence of small leaves that are easy to maintain makes the plant a perfect candidate for landscaping. Currently, *B. molineti* becoming popular as it is incorporated into building design and landscaping in Malaysia. It is considered as a small perennial and slow growing plant that usually propagated by seed and stem cutting. Yet, there is lack of study and very limited knowledge reported on propagation of *B. molineti*. Hence, this study was proposed to investigate the effects of various growing media and the application of commercial hormone on the vegetative propagation of *B. molineti* via stem cutting besides identifying the best growing medium for the growth and development of *B. molineti*. In this study, five different types of growing media (100% sand, 100% cocopeat,100% peat soil, 1:1 sand: cocopeat and 1:1 sand: peat soil) were used. The hardwood stem cuttings within the range of 15-20 cm length were selected and planted in the growing media. Analysis on the results clarified the application of commercial hormone affected the vegetative propagation of *B. molineti* via stem cutting as the increment and reduction in mean number of bud production, mean number of leave production and mean number of primary shoot production was observed in this present study. Nonetheless, practically all of the growing media produced similar responses for cuttings with no hormone treatment in weeks 3 and 6. The Various growing media applied in this study also promoted the reduction and increment the mean number of leave production, mean number of bud production, percentage of survival rate and percentage of callus production. In this study, 100% peat soil was considered as the best growing media as it shown 100% survival rate with the highest percentage of leave production, percentage of primary shoot production, percentage of layer produced per cutting and percentage of callus production in week 6. The findings of this study is crucial for early growth and development of *B. molineti* in the nursery. Nonetheless, further study should be done to investigate the effects of other factors in vegetative propagation of *B. molineti* especially in the root production.

Keywords: Dwarf geometry tree, landscape plant, peat soil, shoot and leave production and callus production.

Pembiakan Vegetatif *Bucida molineti* (Spiny Bucida) melalui Keratan Batang

Charlene Joy Anak Cleveland

Plant Resource and Management
Programme Faculty of Resource
Science and Technology
University Malaysia Sarawak

ABSTRAK

Bucida molineti tergolong dalam keluarga Combretaceae, merupakan tumbuhan hiasan yang terkenal dengan struktur seni bina yang megah. Ia biasanya dikenali sebagai spiny bucida, spiny black olive dan dwarf geometry tree yang menggambarkan ciri-ciri uniknya. Keindahan estetik kanopinya dengan dahan yang terbentang luas memberikan lebih teduhan manakala kehadiran daun-daun kecil yang mudah diselenggara menjadikan tumbuhan itu sesuai untuk landskap. Pada masa ini, B. molineti semakin popular kerana ia digabungkan dalam reka bentuk bangunan dan landskap di Malaysia. Ia dianggap sebagai tumbuhan perrenial kecil dan tumbuh perlahan yang biasanya dibiakkan dengan biji benih dan keratan batang. Namun, kurang kajian dilaporkan dan pengetahuan adalah sangat terhad tentang pembiakan B. molineti. Oleh itu, kajian ini dijalankan untuk menyiasat kesan pelbagai media dan penggunaan hormon komersil terhadap pembiakan vegetatif B. molineti melalui pemotongan batang selain mengenal pasti medium terbaik untuk pertumbuhan dan perkembangan B. molineti. Dalam kajian ini, lima jenis media yang berbeza (100% pasir, 100% cocopeat, 100% tanah gambut, 1:1 pasir: cocopeat dan 1:1 pasir: tanah gambut) telah digunakan. Keratan batang kayu keras dalam lingkungan 15-20 cm panjang telah dipilih dan ditanam dalam media yang disediakan. Analisis terhadap keputusan menjelaskan penggunaan hormon komersial mempengaruhi pembiakan vegetatif B. molineti melalui keratan batang dimana peningkatan dan pengurangan dalam purata bilangan pengeluaran tunas, purata bilangan pengeluaran daun dan purata bilangan pengeluaran pucuk primer diperhatikan dalam kajian ini. Pelbagai media yang disediakan dalam kajian ini turut menyebabkan pengurangan dan penambahan purata bilangan pengeluaran daun, purata bilangan pengeluaran tunas, peratusan kadar kemandirian dan peratusan pengeluaran kalus. Dalam kajian ini, 100% tanah gambut dianggap sebagai media terbaik kerana ia menunjukkan kadar kemandirian 100% dengan peratusan paling tinggi diperhatikan untuk puratan bilangan pengeluaran daun, peratusan pengeluaran pucuk primer, peratusan lapisan yang dihasilkan setiap keratan dan peratusan pengeluaran kalus pada minggu ke-6. Dapatan kajian ini amat penting untuk pertumbuhan awal dan perkembangan B. molineti di tapak semaian. Walau bagaimanapun, kajian lanjut perlu dilakukan untuk menyiasat kesan faktor lain dalam pembiakan vegetatif B. molineti terutamanya dalam pengeluaran akar.

Kata Kunci: *Dwarf geometry tree, tumbuhan landskap, tanah gambut, pengeluaran pucuk dan daun serta pengeluaran kalus.*

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

UNIMAS	University Malaysia Sarawak
PITAS	Pusat Islam Tun Abang Salahuddin

CHAPTER 1

1.0 Introduction

Ornamental plants are those that are grown for their aesthetic value rather than their functional value. While some plants are both attractive and functional, the term "ornamental plants" is often used to describe plants with no other value beyond their visual appeal. They are common in public areas like schools, shopping malls, workplaces, and roadways. Lighting, temperature, relative humidity, and moisture are all different in different areas that require landscaping. The choice of ornamental plant for specific environments is a key decision for interior designers, landscapers, as well as homeowners. *Bucida* spp. are among the ornamental tree and have recently gained popularity as a landscape plant.

1.1 Background Study

Bucida sp. or commonly known as Spiny Bucida, Spiny Black Olive and Dwarf Geometry Tree belongs to Combretacea family. The plant species is native of the upper Florida Keys, does not produce edible olive that people are familiar with, but it does produce a small, black seed-capsule. Spiny black olive is a 40 to 50-foot-tall evergreen tree with a smooth trunk that supports strong, wind-resistant branches. Young plant has a pyramidal appearance, but as it grows older, it develops a dense, full, oval to rounded crown. With time, the crown of the tree flattens down and the tree grows horizontally (Figure 1). The branches, leaves, and reproductive structures extending from the trunk or main stems of a woody plant (tree, shrub, liana) are referred to as the crown. The leathery leaves are twoto four inches long and crowded at branch terminals, occasionally combined with the 0.5 to 1.5-inch-long spines found along the branches (BCI, 2022).

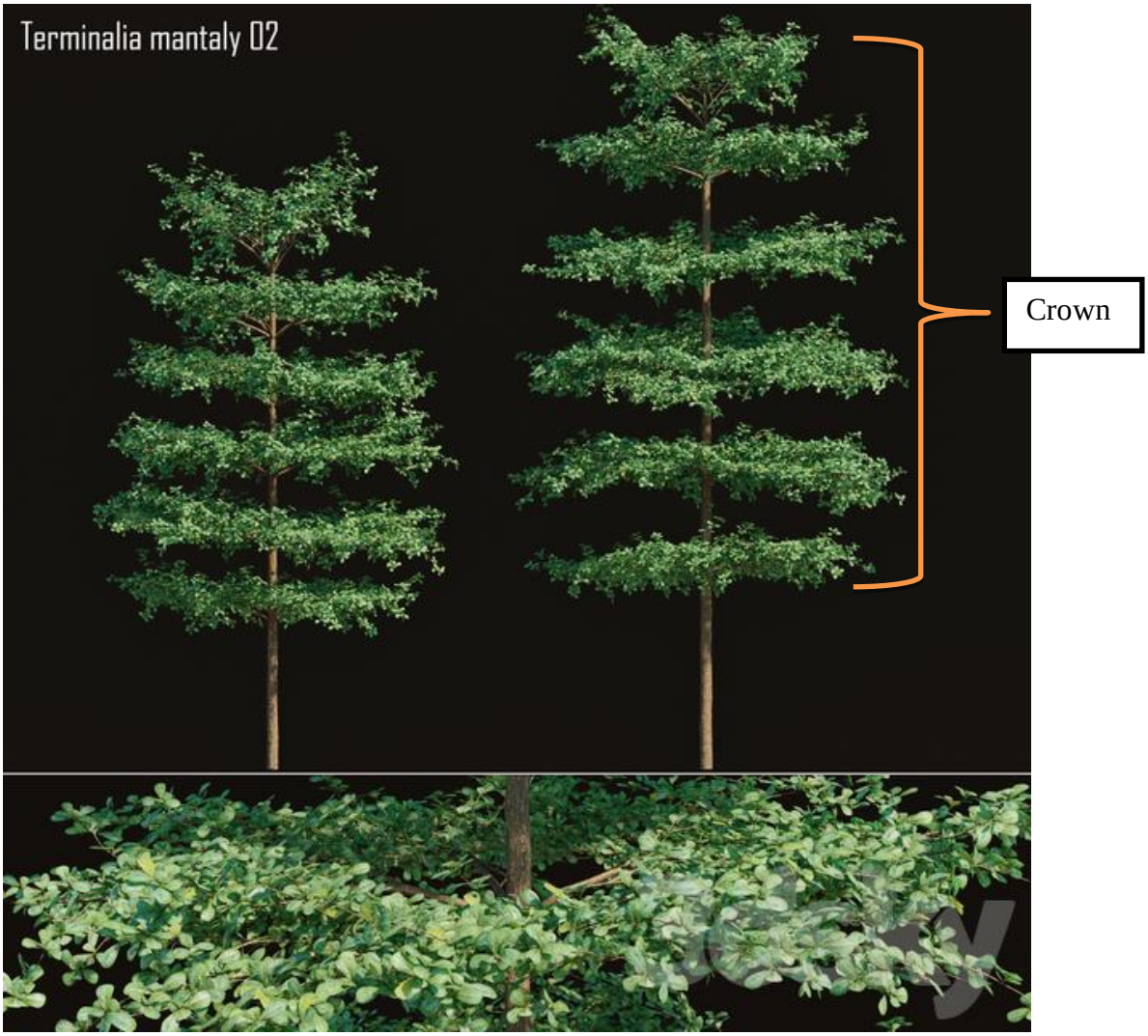

Figure 1: *Bucida molineti*

(Retrieved from https://3dsky.org/3dmodels/show/bucida_molineti_02)

According to horticultural John Lesniewicz, a unique bonsai subject that could become more popular as an urban tree. He describes bucida as a "fragile tree from Florida and the Caribbean that matures into a bonsai by itself." (BCI, 2022). Bucida is a good plant for indoor bonsai because of its natural ability to bend at every internode, forming a bend of 25 to 35 degrees. The Bucida's windswept branches are windswept in nature, so it's a great choice for indoor design. So far there are no major pests or diseases to be concerned for *Bucida sp.*, but sooty mould and bark borer may cause adverse effect for severe infestation. Eryphide mites cause galls, but there is no treatment is required. *Bucida buceras* (Bahama black olive) and *Bucida spinosa* (other name for *Bucida molineti*) are the two potential species for bonsai.

Nowadays, *B. molineti* trees are popular and have been commercially produced due to great demand among landscapers. They are also recognized as a container and bonsai plant tree, originated from Bahamas. In Malaysia, the *B. molineti* trees areplanted as the ornamental and landscape trees, named as Pokok Doa due to their unique characteristics. In the article Trees of UM (2015), *B. molineti* popular as a bonsai plant besides as a decorative in the gardens, parks, along roadsides and streets because of its attractive tiered branches. Additionally, the dry wood of this species has termite-resistant property which indicates the potential used in construction of houses and fences, scaffolding, rail-road ties, andpilings. Furthermore, the bark of *B. molineti* has the tanning agent, a medicinal property. The bark usually applied in combination with the bark of the mangrove, *Rhizophora mangle* to halt bleeding. (Trees of UM, 2015). Its popularity and profits offers higher rate of return. A large and matured tree fetches a really good price in the market.

B. molineti could be propagated sexually by seeds and asexually by stem cuttings. Typically, vegetative propagation by stem cutting entails removing a part of a parent plant's

stem and manipulating it to form a new individual plant. Stem cutting is preferred in conventional propagation of *Bucida* to produce a uniform (clone) plantlet that is genetically identical to the parent. The cuttings usually obtained from the seedling's vertical axis, which contains several nodes with leaves. This is the easiest and cost-effective propagation technique compared to the others. Natural propagation by seed takes longer periods to complete stages from young (juvenile phase) into adult or mature plant (reproductive phase) and lead to longer period of flowering and fruiting (Hackett, 2011). Furthermore, the obstacle in seed germination is the seed dormancy and viability. Some of the seeds might not germinated and promoted slow growth rate after too long storage period. *Bucida* is a perennial and semi deciduous plant that is considered as the slow growing tree species. Hence, vegetative propagation by stem cutting which is cost effective and could provide genetically identical plantlets is practical forcultivation of *Bucida.*

1.2 Problem Statement

Bucida molineti is a small, low and picturesque spreading plant, popular in Malaysia especially for ornamental and landscaping due to its aesthetic beauty of its large, dense, and horizontal spreading canopy. The plant can be trained into a bonsai and suitable for container gardening either in door or out door. Besides, other benefits includes it has potential for construction industry such as for building house posts, fences, scaffolding, and bridge timbers due to its dry wood features has termite-resistant, extremely hard and long-lasting. Other than that, the bark can be processed into leather and applied medicinally as styptic agent, immune system stimulant, antioxidant etc. Although the plant is widely cultivated in Malaysia, however there is very little information reported on this plant species and up to date, lack of study investigated on plant propagation of *B. molineti*. Thus, this study was conducted as a preliminary study for regeneration of the plant species via stem cutting.

1.3 Objective

The objectives of this study were

i. to investigate the effects of various growing media and the application of commercial hormone on vegetative propagation of *Bucida molineti* via stem cutting and

ii. to identify the best growing medium for the growth and development of *Bucida molineti*.

CHAPTER 2

2.0 Literature Review

2.1 Description of *Bucida molineti*

Bucida molineti classified under flowering plants in the Indian almond family, Combretaceae that is grouped in Myrtales order. The Combretaceae family also called as the white mangrove has approximately 530 species of trees, shrubs and lianas that categories in 10 genera. The species are abundantly found in the subtropical and tropical regions.

Taxonomy classification of *B. molineti* (syn. *Terminalia molineti* M. Gómez) is stated as follows:

Kingdom: Plantae

Division: Tracheophytes

Subdivision: Spermatophytina

Class: Magnoliopsida

Order: Myrtales

Family: Combretaceae

Genus: *Terminalia*

Species: *molineti*

(Retrieved from:

https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=895383#null)

2.1.1 Morphological characteristic of *Bucida molineti*

There are several common names of *B. molineti* viz. Spiny Bucida, Black Spiny Olive, Dwarf Geometry Tree or Pokok Doa in Malay language, Malaysia. Yet, there are very limited information on the plant species and lack of research was done on *Bucida molineti*. Thus, comparisons were made with *Bucida buceras* (syn. *Terminalia buceras* Wright) and *Bucida spinosa Jennings* (syn. *Bucida molineti*) which classified in the same genus belong to the family Combretacea (Morton, 1993). *Bucida buceras* also known as the black olive is a tall, straight tree that grows within the range of 24 to 80 feet tall, with trunks up to 3 feet in diameter. Its tiered branches are more or less horizontal, drooping at the ends, and have a varied growth habit. Twigs (a very small thin branch that grows out from a main branch of a tree or bush) are forked (zigzag) and bare at the tips, where the whorled leaves are close-set, alternating, spatulate to elliptic. The leaves are leathery and can reach a length of 3-1/2 inches. Some trees have no spines, while others have sharp spines usually develop on the young, lowerbranchlets within 1/4 to 3/4 inch of length (Morton, 1993).

Bucida molineti or the spiny bucida is a tiny, low and attractive spreading plant that grows to up to 4 feet in height. The mature leaves are light green in colour and variegated while the young leaves are bronze-colored. The tree's branching behaviour is similar to that of *Terminalia catappa* (Ketapang). The twigs' distinctive feature is clearly seen as they grow densely in levels on whorls around the stem. Meanwhile, the flowers are small and golden in colour which eventually developed into the clusters of little brown fruits. *Bucida molineti* named as *B. spinosa* due to the stem characteristic which covered by spines (Trees of UM, 2015).

2.1.2 Distribution and usage of *Bucida molineti*

According to Morton (1993), *B. buceras* are found growing naturally from southern Mexico and Yucatan to Panama, via Guatemala, El Salvador, Costa Rica, Hondura, and Belize, as well as the coasts of Colombia, Venezuela, and the Guianas. It is "doubtfully native", but is cultivated in Barbados, and its range extends northward from Guadeloupe to Jamaica, Cuba, Hispaniola, Puerto Rico and the Virgin Islands, the Bahamas, and the Caicos Islands.

Earlier study reported *B. buceras* were brought from Jamaica several years ago survived and the two excellent specimens grew in Miami (Morton, 1993). The trees produced seeds and they have been distributed widely, and that was the beginning to grow and apply it as a road tree. Besides, many of these species are grown as shade trees and ornamentals (Morton, 1993). It was planted along parkways due to its great attractive foliage with lovely tiered branches and provide superb shade canopy. Other than landscaping, the trees also can be processed and used for construction, textile, medicinal and cosmetic industries.

2.1.3 Disease of *Bucida molineti*

Trees in the urban parks provide valuable benefits, particularly in terms of the environment issue. In order to thrive in an urban environment, urban trees must be in good health and grow well. Some Malaysian urban tree failures were caused by fallen trees, galls, mechanical injuries, and diseases such as canker. Even the *B. molineti* tree is resistance to termite, Terhem et al., (2021) reported that it can be infected with an unidentified canker. Canker symptoms included stretched and sunken bark on the trunk and cracked and discoloured bark on the branch portions (Terhem et al, 2021).

2.2 Vegetative propagation by stem cutting

2.2.1 The importance of vegetative propagation

As a means of assuring reproduction, many native plants naturally propagate vegetatively either without seeds or spores. Vegetative propagation is most common in species with short seed lives, low seed viability, or complex or delayed seed dormancy mechanisms. Vegetative propagation can be done with cutting or pieces of stems, leaves, roots, bulbs, corms, tubers, and rhizomes. The time of year, as well as environmental conditions, all have a part in effective propagation. How plants are handled after roots is equally essential (Luna, 2009). The mainly importance of vegetative propagation is to maintaining the quality of the plant's genetic and the specified qualities of the individual plant, or producing the same quality as the parent (Haapala, 2004). In general, vegetative propagation is better than seed propagation because more nursery stock is acquired in a shorter amount of time. Seed propagation is difficult, time-consuming, and yields few viable seeds. There is a need to reduce the time it takes to flower in order to produce seeds. A uniform stock type is required. Then, to maintain the production, studies have been done to raise planting stocks through stem cutting. Stem cutting is a standard technique since it is a low-cost, easy, effective, and quick way to generate a clone of a parent plant (Leakey et al., 1990). Vegetative propagation of ornamental plants by stem cutting is one of the cheapest and, in some cases, the only method of multiplication available. However, wide variability is observed in different cultivars of the same species under normal conditions; while some cultivars root easily, others are either difficult or fail to root. (Eed et al., 2015).

2.2.2 Success of rooting of certain landscape tree species by stem cutting

Many landscapes ornamental tree species have been successfully propagated vegetatively by stem cuttings. There are various ways to use stem cuttings, and many factors influence how these procedures are carried out. The time of year, age and health of the parent plant, kind of rooting soil, temperature, air circulation, light, and many other parameters all play an important role in the operation's success. Stem cuttings are those that are taken from either new or old growth from the stem or branch of a plant. The ability to root differs between tree species, clones within species, and plants within clones. The propagator's care of the cuttings also influences their ability to grow roots. This includes the use of auxins and other growth regulators, as well as rooting cofactors and other factors (Leakey, 1985).

2.2.3 Factor affecting rooting of cuttings

According to Vineeta (2017), cutting rooting ability is affected by the size of the cutting, age, time, hard, moderately hard, soft, or herbaceous nature of the cutting, and environmental factors. Propagators often choose strong, vigorous, well-matured shoots with viable buds as sources of cuttings for propagation. The maturity of stem cuttings is vital in rooting, because cuttings obtained from young soft stems root more profusely. The kind of media applied in the propagation structure affects rooting success since these materials offer physical support, oxygen, water, and rooting hormones. Moreover, based on Mesen (1993), some of the factors both pre-severance and post-severance, are widely acknowledged as having a significant impact on the rooting ability of leafy cuttings. The effects of these factors, as well as their impact on the physiological processes known to influence adventitious root formation in cuttings. Post-severance factors include both those within and between shoots, which are affected by stock plant age and size, soil nutrition, and environmental factors like light and

temperature, whereas the post-severance, the important factors mediated by photosynthesis, transpiration, respiration, and carbohydrate mobilization, as well as the effect of growth regulators like auxins, are cutting size, leaf area, the minimization of physiological water stress such as drought due to medium saturation in the rooting medium (Koleng, 2019).

2.2.4 Effects of rooting medium in stem cuttings

The type of rooting medium used can have a major impact on cutting rooting capacity. Because aeration and water holding capacity of the media are frequently inversely related, a balance must be achieved to ensure optimal rooting (Mabizela et al., 2017). This statement also supported by Abdel-Rahman (2020), the most important factor in the quality, rooting, and growth of cuttings in many plants is the rooting medium. A good propagation medium would give the plant enough support, nutrients, and hold the plant's available water. The pH of the best rooting media must be favorable for optimal nutrient availability and texture. The majority of organic and mineral mixtures are used as plant propagation media (Abdel-Rahman, 2020).

In common, the sand is the best medium for propagating the stem cutting. Based on the Tchoundjeu et al. (2002), the percentage of cuttings rooted was significantly greater ($P < 0.05$) in sawdust (80%), than in sand alone (72%) or in mixture with sawdust (71%) for *Prunus africana*. Researchers have long noted a wide range of rooting potentials and propagation media requirements between species within the same family, and even between varieties within the same species. A good propagation medium should be porous to allow for adequate aeration. Dolor et al. (2009), also claimed that when cuttings are stuck in highly water saturated propagation mediawith a small air pore space, rooting is reduced.

Cocopeat is an agricultural by-product made from the fibre extracted from the coconut husk. In the tropics, cocopeat can be used to produce a variety of crop species of acceptable quality. It has good physical properties, a large total pore space, a high-water content, and