Faculty of Resource Science and Technology

STUDY OF SEED MATURITY ON GERMINATION AND SUBSEQUENT GROWTH OF TULANG DAING (*Millettia atropurpurea*)

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Study of Seed Maturity on Germination and Subsequent Growth of Tulang Daing

(*Millettia atropurpurea*).

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This Project is submitted in partial fulfilment of the requirements for degree of Bachelor of Science with Honours
(Plant Resource Science and Management)

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Study of Seed Maturity on Germination and Subsequent Growth of Tulang Daing (*Millettia atropurpurea*)

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ABSTRACT

Millettia atropurpurea, or commonly known as Tulang Daing is a beautifull tall evergreen tree belonging to Fabaceae family. It has been used as a timber and also planted as a wayside tree. The seeds of *Millettia atropurpurea* can be used as biodiesel fuel. In this study, two experiments were carried out. In experiment 1, a total 270 seeds of *M. atropurpurea* from three different stages of maturity were sown. 90 seeds were soaked in no treatment solution as control (T_1), hot water soaked for 20 minutes (T_2), and Gibberellic acid for 24 hours (T_3) respectively. While for Experiment 2, about thirty healthy seedlings of *Millettia atropurpurea* were taken of almost equal size from Experiment 1 in each maturity stages. They were potted in a 10cm x 12cm plastic pot containing 1:1 top soil and coconut peat. The readings of plant growth were taken in terms of number of leaves, height, diameter and leaf area within 2 months. Results in Experimet 1 indicated that M2 and M1 were the best maturity stage for *M. atropurpurea*, where they attained 48.89% and 28.89% of seed germination respectively. The best treatment was from T2 with 47.78% of seed germination. In experiment 2, all the types of maturity stages showed positive growth in terms of height, diameter, number of leaf and leaf area of *M.atropurpurea.*

Keywords : *Millettia atropurpurea* seeds, seed pretreatment, seed maturity stages

ABSTRAK

M. atropurpurea atau biasanya dikenali sebagai Tulang Daing adalah pokok malar hijau yang tinggi tergolong dalam famili Fabaceae. Ia telah digunakan sebagai kayu dan juga ditanam di tepi jalan. Biji benih M. atropurpurea boleh digunakan sebagai bahan api biodiesel. Dalam kajian ini, dua eksperimen telah dijalankan. Untuk eksperimen 1, sejumlah 270 biji benih M. atropurpurea daripada 3 peringkat kematangan telah disemai. 90 biji benih masing telah direndam dalam larutan tanpa rawatan sebagai kawalan (T_1), air panas selama 20 minit (T_2), dan asid Gibberellic selama 24 jam (T_3). Manakala dalam Eksperimen 2, lebih kurang 30 anak pokok M. atropurpurea yang sihat dipilih berdasarkan saiz yang sama di setiap peringkat kematangan daripada Eksperimen 1. Mereka dipindahkan ke dalam pasu plastik berukuran 10 cm x 12 cm yang mengandungi 1:1 tanah dan gambut kelapa. Bacaan pertumbuhan dicatat iaitu melalui bilangan daun, ketinggian, diameter dan luas daun selama 2 bulan. Hasil kajian daripada Eksperimen 1mendapati bahawa M2 dan M1 adalah peringkat kematangan yang baik untuk M. Atropurpurea apabila masing-masing mencapai sehingga 48.89% dan 28.89% percambahan biji benih. Rawatan yang terbaik adalah daripada T2 dengan 47.78% percambahan biji benih. Untuk Eksperimen 2, didapati bahawa kesemua jenis peringkat kematangan menunjukkan pertumbuhan yang positif melalui ketinggian, diameter, bilangan daun, dann luas daun pada M. atropurpurea

Kata kunci : biji benih Millettia atropurpurea, rawatan biji benih, peringkat kematangan

CHAPTER 1

INTRODUCTION

1.1 Background

Millettia atropurpurea or locally known as Tulang Daing is a large evergreen tree which grows to a height up to 35m tall. It is also known by its vernacular names such as tulang daing, tulang dain or jenaris (Malay), purple millettia (English) (Quattrocchi, 1999). According to The Plant List (2013), the scientific term of *Millettia atropurpurea* have other synonym which is *Callerya atropurpurea*. *Millettia atropurpurea* is native to countries from Burma to Indonesia. It is widely planted as an ornamental tree in the tropics (Wee & Gopalakrishnakone, 1990).

This Purple Millettia grow vigourously on such poor soil as stony laterite and can be seen from its abundance in the hinterland of Malacca between Gemas and Tampin. It grows frequently in villages, open country and high forest especially in the north of Malaysia. In addition, it is abundantly present around Tampin, Negeri Sembilan. After early establishment, the seedlings will grow rapidly and if left intact, they will be develop into an umbrageous canopy of foliage from the ground. The Purple Millettia can be recognised easily without difficulty from the fallen flowers, big seeds and pods. Flowering is seasonal for this Purple Millettia after periods of dry weather (Corner, 1998).

1.2 Problem Statement

Until today, *Milettia atropurpurea* has various uses for ornamental, wayside trees and timber. Besides that, the large scale planting of *Millettia atropurpurea* for biodiesel fuel has lead to great demand for seed supply. However, there has been no information on the right time to collect seed at the moment. The collection was only done for the brown coloured pod. Therefore , it would be better to know whether other different stages of seed maturity that can be used so that more seed can be collected at a time.

1.3 Objectives

1. To evaluate the effect of seed maturity stages on germination of Tulang Daing (*Milletia atropurpurea*).
2. To determine the effect of pretreatment on seed germination
3. To assess the effect of seed maturity stages on subsequent seedling growth of Tulang Daing

CHAPTER 2
LITERATURE REVIEW

2.1 Genus *Millettia*

The genus *Millettia* comprises 13 species in family Fabaceae. The species of Millettia are climbers or large trees. Two species of genus *Millettia* are characteristic riverside trees in the middle and north of the country while the Purple Millettia (*Millettia atropurpurea*) is a not uncommon tree of villages and secondary jungle which should become better known as ornamental. This is because it has the potential of being able to develop a full crown even on poor, hard and ill-drained soil. The genus is interesting because some of the species contain a poison in their roots which is similar to tuba-root (Derris) if not identical with it , the genus is indeed closely allied with Derris the pods. The poison is used to kill fish in the same way as tuba and that of two African species is made into an arrow-poison (Corner, 1998). Morever, the genus are mainly used for their wood and ornamental uses in landscaping or as wayside trees. For example, *Millettia atropurpurea* is widely planted as a wayside tree (Banzouzi *et al.*, 2008).

2.1.1 Distribution of *Millettia sp.*

Millettia atropurpurea is originates from Myanmar, Thailand and West Malaysia. The geographical distribution of *Millettia atropurpurea* are throughout Asia, Burma, Malaysia and Thailand (Bisby, 1994). This species can also be found in nearly every country of sub-saharian Africa, including Cameroon and Tanzania. Mostly, *Millettia sp.* grow in forests or in woodland, shrubland and bushland (Banzouzi *et al.*, 2008). Besides that, *Millettia sp*. is tolerant of extremely poor soil types and resistant to a wide range of adverse climatic conditions which are drought, water logging, light frost, salinity and moisture stress (Millettia Plantations, 2014).

2.2 Characteristics of Millettia atropurpurea

Millettia atropurpurea is a large evergreen tree, up to 35m tall with dense , cylindric or dome-like, green crown. The leaves of this tree are simple, pinnate compound, with 3-4 pairs of leaflets (Wee & Gopalakrishnakone, 1990). The leaves also narrowly oblong with a round base and blunt tip. The sides of the leaves is slightly upcurled, wavy and glossy green. The flowers of *Millettia atropurpurea* are dense, asymmetrical, purple in colour and have smelling rather unpleasant odour and its bearing on short stalk. The petals are dark reddish purple in colour with white colour at the base (Corner, 1998).

Plate 1: Flower of *Millettia atropurpurea.*

The pods of *Millettia atropurpurea* are thick, slightly flattened, leathery and brown in colour. It will split open slowly into two halves when it falls on the ground revealing a large oval seed. Generally, it has 1-2 seeds in a pod but sometimes it can have 3-4 seeds in one pod. The seeds are large, brown in colour and often with darker wavy stripes or dark at one end (Corner, 1998).

Plate 2 : The seeds of *Millettia atropurpurea.*

2.3 Economic importance of *Millettia atropurpurea*

Millettia is a multi-purposes genus. This genus are mainly used for their wood and in the traditional pharmacopeias. Their interests in agroforestry lies in particular in the fact that, being Fabaceae, they consequently improve the fertility of soil and fix atmospheric nitrogen, which enable to increase the yields of crops (Egbe *et al.*, 1998; Hailu *et al*., 2000). Morever, their rustic nature and their fast growth allow them to be cultivate easily. They are able to grow in a fresh, well drained soil, in a sunny place and do not require complicated pruning. (Cheers, 2000). For example, *Millettia grandis* is traditionally used as wind-breaks and can be planted along the grazing grounds as shelter for animals or natural fence. Besides that, some species such as *M. Thonningii* have a capability for human alimentation. The seed is favourable for its oil and for its protein content (Ezeagu & Gowda, 2006).

In addition, the genus *Millettia* presents nearly 150 distinct therapeutic indications in the African pharmacopeias, covering many important pathologies such as intestinal parasitoses, hernias, stomachic, and intestinal pains, regulations of the cycles for the women, feverish paind, wounds, cough and headache. They also are very often indicated like purgative, diuretic and are often used as fishing of hunting poison (Banzouzi *et al*., 2008).

2.4 Factors affecting seed germination

There are four environmental factors that affect the germination of seed which are water, temperature, oxygen and light. The optimal levels of light and temperature are different among species but in order for germination to occur, all seeds need water and oxygen continuously (Pittenger, 2002).

2.4.1 Effects of temperature

The temperature are the most important environmental factors that promote the seed germination in the soil when water is available. For most of the plants, the temperature of the soil determines the fraction of the germinated seeds and the rate of germination if the light and water are available. The germination of the seeds is a complex process where several reactions and individual factors are involved and every process is affected by the temperature (Gairola *et al.,* 2011). Besides that, the temperature is a highly important factor affecting seed germination because it has a strong influence on all biochemical reactions but also, and often mainly, because it has regulates the flux of oxygen reaching the embryo through the seed coat.

The response to temperature depends on a number of factors, including the species, variety, growing region, quality of the seed, and duration of time from harvest (Copeland & McDonald, 2012). The temperature affects the germination of seeds either directly, through action on germination itself, or indirectly, by affecting dormancy and viability. There is a minimum and a maximum temperature below and above which seeds cannot germinate and it varies substantially among the species. Some seeds germinate only at relatively cool temperatures, the thermal optimum being between about 10^{o}C and 20^{o}C and sometimes less. These type of seeds are from temperate climates. In contrast, other seeds germinate only at relatively high temperatures, the thermal optimum being sometimes close to lethal temperatures (35-40^{o}C). Almost all these seeds are from tropical or subtropical plants. While other seeds are able to germinate in a very large temperature range (Bewley, Black & Halmer, 2006).

In most seeds, total germination is enhanced when seeds are exposed to both alternating temperatures and light. The range between high and low temperature seems to be more important than the actual temperatures (Desai, 2004). For example, cotton requires relatively high temperatures for germination, whereas the small grain will germinate at relatively cool temperatures. Russian pigweed seed has germinated on frozen soil and in ice while wild oat may germinate at temperatures of 35^{o}F. Alternating temperatures are often better than a constant temperature for seed germination (Monaco *et al.,* 2002).

2.4.2 Effect of water

Water is a basic requirement for germination. It is essential for enzyme activation, breakdown, translocation, and use of reserve storage material. In their resting state, seeds are characteristically low in moisture and relatively inactive metabolically (Copeland & McDonald, 2012). Germination begins with the seed imbibing or absorbing water and ends with the emergence of the embryonic axis, usually radicle, through the structure surrounding it. The amount of available water in germination medium greatly affects water uptake. An adequate, continuous supply of water is important to ensure germination. Once the germination process has begun, a dry period will cause an embryo to die (Bewley *et al.*, 2012).

According to Monaco *et al*., (2002), germination is normally a period of rapid expansion and high rates of metabolism or cell activity. Much of the expansion is simply an increase in water, expanding cell walls. If water content of the seed is reduced, the activity of enzymes and consequently metabolism will slows down. The amount of moisture contained in seeds may determine their respiratory rate. During germination, the seed respires at a very rapid rate. Many seeds cannot maintain this high rate of respiration until they reach a moisture content of 14% or more. Thus, in dry soils the seed remains dormant.

In addition, dry seeds can tolerate severe conditions. Some seed have been kept in boiling water for short intervals without injury and others in liquid nitrogen. When moist enough for germination, the same seeds may be killed by cold temperatures of 30^{o}F or warm temperatures of 105^{o}F (Monaco *et al.*, 2002).

2.4.3 Effects of oxygen

Besides the right temperature and sufficient water, germination also depends on oxygen. Most seeds require oxygen to germinate, but this requirements largely depends on the species and the dormancy state of the seeds. It is embryo that requires oxygen, but the covering structures may reduce oxygen supply to it and thus determine seed sensitivity to the oxygen (Kigel, 1995). Aerobic respiration requires more free oxygen than anaerobic respiration, thus, some seeds start germination under anaerobic conditions and then shift to aerobic respiration when the seed coat ruptures. The percentage of oxygen found in the soil varies widely, depending on soil porosity, depth in the soil, and organism in the soil that use oxygen and release carbon dioxide. The amount of oxygen needed for seeds to germinate are vary considerably among different species. For example, rice and lettuce will germinate at very low oxygen supply levels, but peas, broad beans and sugar beet will not germinate. However, the importance of these differences in practise is uncertain (Forbes & Watson, 1992).

Furthemore, researchers believe that lower germination is related to a smaller supply of oxygen in waterlogged soils, rather than merely excess water. Seeds germinate deeper in sandy soils than in clay soils as a result of better aeration or better oxygen supply in the sands. Some seeds buried deep in the soil do not germinate but lie dormant for many years. They germinate immeiately when brought to the surface. Besides increased the oxygen supply, aeration is probably responsible (Monaco *et al*., 2002). However, there is limitation of oxygen diffusion to the embryo that caused by seed coats, which depends on the structure, the thickness, and the biochemical properties of the coat tissues. This limitation is also largely under the control of temperature (Kigel, 1995). Depending on the structure, seed coats are more or less permeable to oxygen when they are dry. However, imbibed coats become a barrier to oxygen diffusion since they constitute a continous wet layer around te embryo.